SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER, 1931.

GENERAL PHYSICS.

3284. Density of Carbon Dioxide. D. leB. Cooper and O. Maass. *Canad. J. of Research*, 4. *pp.* 283–298, *March*, 1931.—The work published in a previous communication [see Abstract 3906 (1930)] has been extended and revised. Determinations of the density of carbon dioxide are shown for five temperatures from − 30° to + 77° C., and over a pressure range of 760 to 250 mm. of mercury. The extrapolation of these curves to zero pressure shows a mean value for the atomic weight of carbon = 12·004 ± 0·003. A graph is included which shows the apparent molecular weight as a function of the temperature; molecular volumes have been calculated from this. The results give P–V–T values for CO_2 in the above temperature and pressure range, with an accuracy considered to be greater than available data. AUTHORS.

3285. Density of Sulphur Dioxide. D. leB. Cooper and O. Maass. *Canad. J. of Research*, 4. *pp.* 495–497, *May*, 1931.—The density of sulphur dioxide has been measured by the same method as that previously described [see preceding Abstract], and equations of five isothermals are given. Some evidence of adsorption influence appears in the isothermal at − 7·82° C. The normal density of sulphur dioxide found is 2·9262.

AUTHORS.

3286. Application of Least Squares. W. E. Deming. *Phil. Mag.* 9. *pp.* 146–158, *Jan.*, 1931. *Paper read before the Am. Phys. Soc., Feb.*, 1930.—The principle of least squares has been applied to the general problem of determining the most probable values of observed quantities and of parameters related by equations of various types. The method is based on the principle that the weighted sum of the squares of the residuals is to be minimised with respect to the most probable values and any relevant parameters. The term "general normal equations" is proposed for the symmetrical equations which form the general solution. Current methods of curve fitting are criticised, and a method is described which permits the proper weight to be given to each observation; from the general solution two sets of symmetrical equations are derived, in one of which the only unknowns are the corrections to the approximate values of the parameters, whilst the other set serves to adjust the observations by determining the residuals. Some special cases are illustrated. An expression is developed for the direction cosines of the line joining the observed and the most probable positions of a point plotted on orthogonal axes. For the case in which the observations representing the coordinates of the observed position of a point are of equal weight, this line is normal to an empirical surface which forms the locus of the most probable positions of all the points. [See also Abstract 2377 (1930).] H. F. G.

3287. Natural Limits of Sensitiveness in Measuring Instruments. Part I. The Balance. G. Ising. *Ann. d. Physik*, 8. 8. *pp.* 905–910, *April* 10, 1931.—Natural limits of sensitiveness are determined by the Brownian vibrations of the moving system in various measuring instruments. From general considerations based on the limits thus set an expression for the limits of sensitiveness of the balance is deduced. [For Part II see Abstract 3599 (1931).] J. J. S.

3288. Simplified Humidity Control. W. H. Apthorpe and M. C. Marsh. *Journ. Sci. Instruments*, 8. *pp.* 152–154, *May*, 1931.—A simple, robust humidity control working on the hair principle is described. [See also Abstract 785 (1928).] AUTHORS.

3289. Registering Apparatus for Testing Automobiles. Höffer. *Zeits. f. Instrumentenk.* 51. *pp.* 318–324, *June*, 1931.—The apparatus gives indications of the acceleration and braking of vehicles, especially automobiles, from the instant of braking, coupling, connection, throttling, etc. Full details are given of the several parts of the apparatus. Electric power is obtained from pocket-lamp batteries, and gramophone clockwork is employed. The registrations are made electromagnetically on a chart. R. S. R.

3290. Internal Friction and the State of Fluid Matter. N. Gerasimov. *Phys. Zeits.* 32. *pp.* 444–450, *June* 1, 1931.—On the basis of the internal friction, the isotherms of the quantity b in the gas equation, known as the *Kovolumen* for CO_2, at temperatures of 20°, 30° and 40° and a pressure of 110 atmospheres were calculated, as also the relationships $\left(\frac{\partial b}{\partial \tau}\right)_p$ and $\left(\frac{\partial b}{\partial \tau}\right)_v$. It was found that the minimum of the isothermal curve corresponded to a value for ηv, and also at the critical point for the ratio v/b, equal in both cases to 2. The relationship between the vapour-tension curve and the pressure-temperature curve was investigated in regard to the minimum of the kinematic viscosity. A new method is also reported for the determination of the size of the molecule, and the dependence of the heat of vaporisation on the internal friction is given. Finally, the mathematical expressions obtained are utilised for the determination of the relationships involved. S. G. B.

3291. Viscosities, Surface Tensions and Parachors of Certain Cyclic Hydrocarbons. M. Godchot and (Miss) G. Cauquil. *Comptes Rendus*, 192. *pp.* 1560–1562, *June* 15, 1931.—Data are given for cyclopentane, cyclohexane, cycloheptane and cyclooctane, and for a number of their simple hydrocarbon derivatives. Density and viscosity appear to increase with molecular weight, whilst saturated hydrocarbons have higher values than their corresponding unsaturated members. In the series from cyclohexane to cycloheptane, the methyl derivatives have appreciably lower viscosities than the parent hydrocarbon, but this is reversed in the cyclopentanes and cyclooctanes. Surface tensions increase regularly as the series is ascended. Parachor increments are given for the new ring formations. H. H. Ho.

3292. Surface Tension of Saturated Vapours and the Equation of Eötvös. J. L. Shereshefsky. *J. Phys. Chem.* 35. *pp.* 1712–1720, *June*, 1931.—On the basis of Antonoff's rule and the capillary-rise equation of surface tension, an expression has been deduced which determines the surface tension of saturated vapours. This expression is further developed into a form which relates surface tension of saturated vapours with temperature. The equation is tested for six unassociated vapours and found to reproduce observed results with fair accuracy. The various modifications of Eötvös' law are discussed, and a new one is developed which takes account of the vapour density and is based on the theory of corresponding states. This new equation is tested against the same six compounds in the liquid state and is found to be in good agreement with observed data. H. H. Ho.

3293. Surface Energy of Liquids. H. Margenau. *Phys. Rev.* 38. *pp.* 365–371, *July* 15, 1931.—The paper contains: (1) A brief characterisation of the intermolecular forces producing surface tension and similar phenomena. (2) A review of thermodynamic relations and the development of a statistical theory of surface energy and the corresponding formula. (3) The results of a calculation of the surface energies of seven liquids on the basis of this formula, and their comparison with experiment. The agreement is in all cases as good as is consistent with the uncertainty of the data from which the calculation starts, and may be taken to indicate the applicability of the present theory of molecular forces to simple problems connected with the liquid state. AUTHOR.

3294. Oscillations of Water in Spindle-Shaped and Elliptic Basins and Associated Problems. Part I. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 4. 2. *pp.* 99–219, *Feb.*, 1931. *In English.*—Investigates problems of water oscillations in various types of basins and canals. Chapter I deals with a spindle-shaped basin as a two-dimensional problem, solutions being obtained in terms of Bessel's functions of 1/4th order. Triangular and shield-shaped basins are also considered. In Chapter II the spindle-shaped and elliptic basin of uniform depth are treated as finite canals of varying width, and solutions obtained by the method of Kelvin and Darwin used for integrating the dynamical equations of the tides of long periods. Results for the elliptic basin are compared with Jeffreys' obtained by the method of Baker and Cowley-Levy. For a spindle-shaped basin of given length, the period of oscillation for the lowest antisymmetrical mode is nearly independent of the ratio of width to length. In Chapter III the basin whose width varies as $w = 2b(1 - x^2/a^2)^m$ is investigated, the rectangular, elliptic and spindle-shaped basin being special cases for $m = 0$, $m = \frac{1}{2}$ and $m = 1$, respectively. In Chapter IV the problems for spindle-shaped and elliptic basins with depth varying as $h = h_0(1 - x^2/a^2)$ are solved in terms of hypergeometric functions. In Chapter V the problem is discussed for a basin whose width varies as $w = 2b \cos^{m'}(\pi x/2a)$, m' being any positive number. Chapter VI considers the spindle-shaped and elliptic basin whose depth linearly increases from one end to the other as $h = h_0(1 - x/a)$. The paper is entirely mathematical. H. H. Ho.

3295. Effect of Walls of Rectangular Vessel upon Model Experiments. Y. Miyamoto. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 305 [28 *pp.*], *March,* 1931.—The effect of the walls of a rectangular containing vessel upon the results of measurements of flow either of fluid or current, or heat, etc., carried out upon models contained in the vessel, is discussed by the method of conformal representation. J. S. G. T.

3296. Stability of Motion of a Viscous Fluid. W. T. MacCreadie. *Nat. Acad. Sci., Proc.* 17. *pp.* 381–388, *June,* 1931.—A criterion for the stability of steady motion of a viscous fluid between two parallel planes was given by Reynolds in the form $2\rho b U_m/\mu < 517$, where ρ is the density, $2b$ the distance between the planes, U_m is the mean velocity of the fluid, and μ its coefficient of viscosity. A much lower value of the constant, 167, was derived by Sharpe, and later Orr derived the value 117. The present mathematical analysis shows that by expressing the small motion which is superposed on the steady motion of the fluid (the Reynolds method of solution), in the form of a Fourier series, the Reynolds method gives a result as small as Orr's. Applying the calculus of variations, the minimum value 116·8 is obtained. J. S. G. T.

3297. Stability of Vortex Rings in Compressible Fluids. N. Sen. *Calcutta Math. Soc., Bull.* 23. *pp.* 11–22, *March,* 1931.—The problem of the motion of circular vortex rings in a compressible fluid is discussed mathematically without making the assumptions that vorticity and compression are constant over the cross-section of the ring and concentrated in the circular axis. The aperture of the ring is affected by compressibility of the fluid, whilst the velocity of translation of the ring is only slightly altered thereby. J. S. G. T.

3298. Method of Registration in the Study of Vortices Produced in Liquids. E. Crausse and J. Baubiac. *Comptes Rendus,* 192. *pp.* 1355–1357, *June* 1, 1931.—A hot-wire resistance method is used to measure the speed of the vortices in the liquid, these producing changes of temperature and consequently of resistance in the wire. The method has been applied to (1) the vortices of Bénard-Kármán for a period of 0·8 sec. and Reynolds' law of similarity for alternate vortices in liquids of different viscosities is confirmed; (2) secondary vortices of small dimensions and having for the same speed of the liquid a shorter period than the alternate vortices. Diagrams illustrate the results obtained in both cases. A period of 0·0167 sec. was found for the latter. [See also following Abstract.] R. S. R.

3299. Secondary Vortices Produced in the Rear of an Obstacle Submerged in a Liquid. E. Crausse and J. Baubiac. *Comptes Rendus,* 192. *pp.* 1529–1531, *June* 15, 1931.—Cylindrical obstacles were used, the periods being measured as before [see preceding Abstract] and the speeds obtained chronophotographically or directly. After obtaining alternate vortices, undulations arose at the edges of the obstacle when the speed was increased to a critical value of 3 cm./sec. for obstacles of 8–16 mm. dia., and with higher speeds these undulations change to vortices. The period of the vortices increases (1) at first rapidly with increase of speed, but only slowly for speeds > 40 cm./sec.; (2) with increase of diameter of the obstacle, but little influence exists when the speed > 40 cm./sec.; and (3) with viscosity of the liquid. For water there is little change of period for obstacles with lengths of 300–20 mm. R. S. R.

3300. Motion of a Vortex near Sources, Sinks, Double Sources and Fixed Vortices in the Half Plane. A. Kneschke. *Ann. d. Physik*, 9. 8. *pp.* 905–915, *June* 17, 1931.—The various vortex motions referred to are discussed analytically by the application of Routh's conjugate functions. [See also following Abstract.] J. S. G. T.

3301. Vortex Motion near a Circular Cylinder. A. Kneschke and S. Matthes. *Ann. d. Physik*, 9. 8. *pp.* 916–920, *June* 17, 1931.—The analysis developed in a previous paper [see preceding Abstract] is applied to investigate analytically vortex motion near (1) a fixed vortex, (2) a double source, (3) a source and sink, (4) a single source, (5) a source in translatory motion and (6) a circular cylinder. In addition the motion of a vortex pair near (1) a circular cylinder and (2) a plane is briefly discussed. J. S. G. T.

3302. Statistical Significance of the Kármán Hypothesis of Similarity in the Theory of Turbulence. F. Noether. *Zeits. f. angew. Math. u. Mechanik*, 11. *pp.* 224–231, *June*, 1931.—Kármán's hypothesis of similarity is discussed mathematically as a statistical consequence of his theory of vortex streets. J. S. G. T.

3303. Stability of Discontinuous Fluid Motions. W. G. L. Sutton. *Phil. Mag.* 11. *pp.* 1196–1201, *June*, 1931.—The general equations to be satisfied by a disturbance along a line of discontinuity in the two-dimensional motion of a perfect fluid are obtained and applied to discuss the stability of a single jet bounded by concentric circles. AUTHOR.

3304. Circulation Due to a Cylinder Rotating in a Viscous Fluid. E. G. Richardson. *Phil. Mag.* 11. *pp.* 1215–1220, *June*, 1931.—Measurements of the velocity distribution round a cylinder rotating in otherwise stagnant fluid indicated that the velocity diminished more rapidly than classical theory demanded, especially near the cylinder, the condition u (tangential velocity at distance r in question), $\propto r^{-1}$ being approximately fulfilled at several diameters distance from the surface. The general circulation question is now investigated, theoretical and experimental treatments being included in the paper. H. H. Ho.

3305. Integration of the Hamel-Oseen Hydrodynamical Differential Equation. O. Olsson. *Arkiv f. Mat., Astron., och Fysik, Stockholm*, 22*A*. 3. pp. 1–36, 1931.—Puts $2a - C\rho' = 2\kappa$ in Hamel and Oseen's equation, and integrates it for the case in which κ is a small quantity of such a kind that terms containing $2/a$ or its higher powers as factors can be neglected. E. E. F. d'A.

3306. Additive Colour Changes of Alkali Halide Crystals. Part I. Macroscopic Diffusion Conditions. E. Rexer. *Zeits. f. Physik*, 70. 3–4. *pp.* 159–187, *June* 27, 1931.—By means of a simple diffusion arrangement the temperature and time dependence of the diffusion of metallic sodium into rock-salt has been investigated. The diffusion phenomena are dependent to a high degree on the individual state and previous thermal history of the crystals. The ordinary diffusion laws appear to be obeyed only for untreated crystals of natural origin and for relatively short periods of diffusion; the diffusion is retarded in general by the effects of impurities. Colour shade and intensity of the coloured crystal parts are likewise dependent on the above factors in a systematic manner. When Na is replaced by Li, K, Ca, Sr and Ba, colour effects in qualitative agreement with the Na diffusion in NaCl are obtained. The maximum depth of penetration is different, however, and greater according to the greater thermal effect of the reaction: metal + sodium chloride = sodium + metal chloride. There appears to be a reaction between the metals and the crystal material which liberates Na atoms whereby finally only Na diffusion occurs. The same relationships are obtained for the diffusion of K and the other metals in KCl. H. H. Ho.

3307. Production and Measurement of High Vacua. S. Dushman. *Frank. Inst., J.* 211. *pp.* 689–750, *June,* 1931.—The interest in high vacua has gradually been extending since its initiation about 18 years ago. A description of the progress made in the last decade is given along the following lines: (1) Utilisation of vapour pumps of much higher speeds, (2) use of " getters " or " clean-up " methods to improve vacuum in devices after preliminary exhaust, (3) increasing attention to vacuum treatments of metals and metal parts that enter into the production of vacuum devices. Theories of factors which make for speed and efficiency of working of the pumps are considered, and special attention is devoted to " sorption " of gases by metals. Types of gauges are also discussed. H. M. B.

3308. Intrinsic Equations of Elastic Equilibrium. G. Andruetto. *Accad. Lincei, Atti,* 13. *pp.* 489–494, *April* 12, 1931.—Obtains these equations very rapidly by vectorial methods. A. D.

3309. Elastic Systems Doubly Hyperstatic. G. M. Pugno. *Accad. Lincei, Atti,* 13. *pp.* 508–512, *April* 12, 1931.—Deduces the polar diagram of the parameters of displacement. A. D.

3310. Work in Generalised Space. Angelina Cabras. *Accad. Lincei, Atti,* 13. *pp.* 428–432, *March* 15, 1931.—Full mathematical discussion of the forms of expression for the work. [See also Abstract 715 and 1768 (1931).] A. D.

3311. Equations of Motion of a Rolling Wheel. H. Lenk. *Zeits. f. angew. Math. u. Mechanik,* 11. *pp.* 206–224, *June,* 1931.—The general motion of a wheel, *e.g.*, a motor-car wheel, upon a perfectly hard plane is discussed analytically. The effect of unevenness of the plane is briefly discussed. J. S. G. T.

3312. Resistance of Air to Ballistic Velocities. Gabeault. *Comptes Rendus,* 192. *pp.* 1630–1633, *June* 22, 1931.—The mathematical development of a general expression for the various factors connected with the resistance of the air when a cylindro-ogival projectile is projected into a current of uniform air in a direction along its axis. S. G. B.

3313. Cohesion of Natural Fluorspar Crystals. E. Rexer. *Zeits. f. Krist.* 78. 3–4. *pp.* 251–256, *June,* 1931.—Splitting strength, perpendicular to the octahedral cleavage amounts to 1320 gm./mm.^{2} Plastic deformation at room-temperature could not be established. Impurities are assumed to be responsible for differences observed in individual cases. A comparison may be made with the behaviour of rock-salt [see Abstract 3011 (1930)]. F. I. G. R.

3314. Deformation of Crystals at High Pressures and Temperatures. F. Heide. *Zeits. f. Krist.* 78. 3–4. *pp.* 257–278, *June*, 1931.—The results obtained for temperatures around 400° C. are:

	Translation Faces.	Slipping Faces.
Barytes	(001), (011), (102), (010)	(110), $(1\bar{1}0)$
Celestite	(001), (011), (102)	(110), $(1\bar{1}0)$
Anglesite	(001), (011)	(110), $(1\bar{1}0)$

At room-temperature and at a pressure of approximately 17,000 atmospheres for all three minerals, only the translations (001) and (011) occur.
F. I. G. R.

3315. Capacity of Crystal Nuclei for Superheating. R. Bloch, T. Brings and W. Kuhn. *Zeits. f. phys. Chem.* 12. *Abt. B.* 6. *pp.* 415–426, *June*, 1931.—The stability of crystal nuclei in superheated melts is considered on the basis of kinetic considerations on the process of fusion, and it is shown that small crystals melt the more slowly, although thermodynamically they are at least as unstable as large crystals at the corresponding temperature. It is essential that the melting process is regarded as a surface phenomenon in which, according to Kossel and to Stransky, an attacked boundary face falls away quickly, whereas gaps and unattacked boundary faces break down slowly and with expenditure of activation energy. An interpretation is also deduced of the intermittent phenomena which, on statistical grounds, appear if larger crystals are broken down to nuclear magnitude. T. H. P.

3316. Atomic Working-Ranges with Tetrahedral Symmetry as Common Structural Elements in all Crystal Lattices. R. Reinicke. *Zeits. f. Krist.* 78. 3–4. *pp.* 334–362, *June*, 1931.—The paper is essentially geometrical rather than physical. Spherical atomic working-ranges are replaced by tetrahedral ones (applied in particular to the diamond). For convenience in manipulation these tetrahedra are combined in pairs, one negative and one positive, to form cubes, and from these it is possible to derive the coordination beyond the first environment. Thus, the coordination numbers for diamond (usually taken as equal to four for the first " sphere ") are 4, 12, 12, 6 for the first four sets. Extensions of the method are given for the wurtzite structure and for hexagonal lattices. F. I. G. R.

3317. Orientated Separation of Crystal Ions and Formation of Grimm's Mixed Crystals. I. N. Stranski. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 230–238, 1931.—This work continues a previous investigation [see Abstract 468 (1930)] on the upper limits of super-saturation whereby isomorphous ionic crystals separate together, for the case where both crystals are of the type AB, and only differ by the charges on the ions formed. The formation of Grimm's mixed crystals of divalent in presence of univalent ions is then discussed. H. H. Ho.

3318. Crystal Structure of Fe_2B. G. Hägg. *Zeits. f. phys. Chem.* 12. *Abt. B.* 6. *pp.* 413–414, *June*, 1931.—A correction to the author's former paper [see Abstract 1456 (1931)]. F. J. W.

3319. Crystal Structure of Silicon Tetra-Iodide and the Tetrahalides of the Lighter Elements. O. Hassel and H. Kringstad. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2, *pp.* 1–12, *June,* 1931.—Laue rotation and Debye analyses show that SiI_4 is cubic with 8 molecules in the unit cell, of edge-length 11·99 Å. It appears that the structure of this compound corresponds to that of SnI_4 and GeI_4. The space group for all of them is most probably T_h^6, but this requires 4 molecules to the unit cell in place of 8. The difficulty is resolved on perceiving that the molecules form " islands " in Weissenberg's sense. Association is thus indicated.
F. I. G. R.

3320. Crystal Structure of Methane, Part II. H. H. Mooy. *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 660–662, 1931.—With the crystal films used in Part I [see Abstract 2928 (1931)] there was uncertainty about the intensities of the reflections (220) and (400), as the lines corresponded with lines from the supporting copper rod. A silver rod has now been used, and the intensities of the various lines due to films of methane have been carefully compared. Assuming the four carbon atoms in the elementary cube to be crystallographically identical, with the same assumption regarding the sixteen hydrogen atoms, the only possible space groups are T^2 and T_d^2. Fairly satisfactory agreement with the experimental values was obtained, assuming a distance from C to H of 0·09 Å.; the distance calculated from the moment of inertia, obtained by analysis of the infra-red bands, is 1·13 Å.; but this, of course, is for the gas phase. The author concludes from the intensities of (420) and (531) that the space group is T_d^2.
H. N. A.

3321. Crystal Structure of Hexaminobenzene. I. E. Knaggs. *Roy. Soc., Proc.* 131. *pp.* 612–620, *June* 3, 1931.—Powder photographs show that the unit cell has $a = 15 \cdot 14$ Å., and contains 16 molecules; space group O_h^8. The molecule has threefold symmetry; a structure for it is suggested. The density is greater than 1·1; the coefficient of linear expansion between −183° and +15° = 0·000102.
C. A. S.

3322. X-Ray Study of Mannitol, Dulcitol and Mannose. Thora C. Marwick. *Roy. Soc., Proc.* 131. *pp.* 621–633, *June* 3, 1931.—The results obtained were as follows:

	Space Group	*a.*	*b.*	*c.*	*β.*	Density.	Molecules per Cell.
						gm./c.c.	
Mannitol . .	Q_4	8·65 Å.	16·90 Å.	5·56 Å.	—	1·497	4
Dulcitol . .	C_{2h}^5	8·61	11·60	9·05	113° 45′	1·466	4
Mannose . .	Q_4	7·62	18·18	5·67	—	1·501	4

It appears that in all three cases the long dimension of the molecule corresponds to the *a* axis. In the alcohols the molecules appear to have the long-chain configuration; in the sugar that of the manno-pyranose ring. A photograph of a model illustrating the structure of mannitol is reproduced, and the way in which the mannitol structure passes into that of dulcitol is made clear. An account is given of the measurement of the area of cross-section of the alcohol end group CH_2OH.
H. N. A.

3323. Crystal Structure of Lithium Iodate. W. H. Zachariasen and F. A. Barta. *Phys. Rev.* 37. *pp.* 1626–1630, *June* 15, 1931.—The structure of lithium iodate was determined by using the oscillation and powder methods. Lithium iodate is hexagonal with 2 molecules per unit cell of $a = 5{\cdot}469 \pm 0{\cdot}003$ Å., $c = 5{\cdot}155$ Å. $\pm\ 0{\cdot}005$ Å. The space group assigned is D_6^6 and the atom positions are: 2Li in (001/4) (003/4), 2I in (1/3 2/3 1/4) (2/3 1/3 3/4) and 6O in $(uu0)$ $(0\bar{u}0)$ $(\bar{u}00)$ $(\bar{u}\bar{u}\tfrac{1}{2})$ $(0u\tfrac{1}{2})$ $(u0\tfrac{1}{2})$, with $u = 1/3$. The structure is based on hexagonal closest packing, with the lithium and iodine atoms both lying within oxygen octahedra. The atomic distances are Li — O and I — O = 2·23 Å. with lithium octahedra sharing faces with each other, one lithium and one iodine octahedra sharing only edges and two iodine octahedra only corners. AUTHORS.

3324. Diffraction Rings Produced by Spherolites with Helicoidal Winding. P. Gaubert. *Comptes Rendus,* 192. *pp.* 1576–1579, *June* 15, 1931.—A source of light viewed through a film of cholesterol containing 5 % anisaldazine or 10 % cetyl *p*-azoxycinnamate, shows a dark zone surrounded by one or more coloured (diffraction) rings due to two series of helicoidal spherolites of differing pitch. The diffracted light is polarised perpendicular to the radius of the spherolite. For rings to be formed the pitch of the helix must not exceed 0·12 mm. in the case of cholesterol. Helenine with a pitch of 0·5 mm. gives no rings, naphthyl benzoate, thebaine and codeine with very small pitches, all show them. The number of rings depends on the double refraction, and their diameter varies inversely as the pitch. C. A. S.

3325. Spinel Structure: An Example of Variate-Atom Equipoints. T. F. W. Barth and E. Posnjak. *Washington Acad. Sci., J.* 21. *pp.* 255–258, *June* 19, 1931.—Two questions arise which throw doubt on the justification of the usual spinel structure, the departures from Goldschmidt's radius ratio and the apparent lack of constancy of ionic radii. The spinels, magnesium ferrite and magnesium galliate, are discussed from this point of view. Partial replacement in lattice positions which are structurally equivalent seems to be an effect not restricted to spinels alone. Unit cells which have this property are called cells with variate-atom equipoints. F. I. G. R.

3326. Development of Starring in Rock-Salt Crystals. Irena Manteuffel. *Zeits. f. Physik.* 70. 1–2. *pp.* 109–113, *June* 20, 1931.—The development of individual pressure figures in rock-salt is followed by means of Laue photographs, and is found not to proceed continuously with increase of load. At a definite value, the image of the diffracted X-ray first divides into two, and, as the load increases, into several spots. On further loading the spots become diffuse, and spread out in two directions, the more strongly in that of the primary spot. This separation of the individual spots of the Laue diagram into several separate ones is claimed as evidence of the existence of a crystal mosaic in the optically homogeneous crystal. C. B. A.

3327. Crystal Structure of Arsenic Triiodide, AsI_3. Dorothy Heyworth. *Phys. Rev.* 38. *pp.* 351–359, *July* 15, 1931.—The crystal structure of arsenic triiodide has been investigated by means of Laue, powder and oscillation photographs. It is shown to be a layer lattice. The underlying lattice is Γ_{rh} and the space group C_{3i}^2. The unit rhombohedron has dimensions $r = 8 \cdot 25$ Å. and $\alpha = 51° 20'$; there are two molecules to the unit cell. The coordinates of the atoms are arsenic $\pm uuu$ where $u = 60°$; iodine $\pm xyz$, $\pm zxy$, $\pm yzx$, where $x = 152°$, $y = 28°$, $z = -90°$. Distances of closest approach of iodine are about 4·28 Å. and 4·13 Å., and of arsenic and iodine about 2·97 Å. The iodine ions are in hexagonal close packing; each arsenic ion is surrounded by six iodine ions. AUTHOR.

3328. Structure of Silica Gel. Laura Krejci and E. Ott. *J. Phys. Chem.* 35. *pp.* 2061–2064, *July*, 1931.—Pure precipitated silica has been shown to be entirely transformed into the crystallised state by heating to 1150° C. for five hours. The crystals obtained are of the cristobalite modification. Precipitated silica samples which have never been heated above 500° C. show distinctly the presence of crystalline centres of colloidal dimensions. The same is true for a freshly prepared sample which has at no time been heated above 100° C. The X-ray patterns of these silica gels are apparently identical and indicate the crystals to be of the cristobalite type. AUTHORS.

3329. Triatomic Hydrogen. J. L. Binder, E. A. Filby and A. C. Grubb. *Canad. J. of Research*, 4. *pp.* 330–343, *April*, 1931.—A study was made of the activation of hydrogen in the a.c. corona discharge at atmospheric pressure. The resulting test for sulphide was negative unless the gas contained a small percentage of oxygen. Oxygen promoted the activation by acting as a wall poison. Stearic acid also acted as a wall poison in a vacuum tube discharge through hydrogen at pressures from 20 to 80 mm. The hydrogen was freed from oxygen by passing gas from a compressed cylinder over platinised asbestos heated to 550° C. A fatigue effect appeared which was found to be due to the oxygen content of the hydrogen and to the condition of the walls of the discharge tube. Quantitative determinations of the relation between concentration of the active gas and the velocity of hydrogen showed that, at 42 mm. pressure, the concentration varied directly with the velocity up to an optimum flow of 2·4 litres per hour. At a higher rate the concentration varied inversely with the velocity. The percentage activation was found to vary inversely with the pressure between 30 and 80 mm. In the corona discharge the maximum per cent. activation for hydrogen containing 0·1 % of oxygen was 0·001. A concentration of 0·025 % active hydrogen was found for the vacuum discharge in a tube the walls of which were poisoned with stearic acid, and in which the pressure and velocity were 42 mm. and 2·4 litres respectively. AUTHORS.

3330. Duration of Metastable States. J. M. Anderson. *Canad. J. of Research*, 4. *pp.* 312–321, *April*, 1931.—Improved experimental methods for the measurement of time durations of metastable atoms have been developed, and measurements made for a series of pressures at room temperature and at liquid-air temperature of the decay curves for the absorption of 7635 Å. in argon. AUTHOR.

3331. Determination of the Equilibrium between the Atoms and Molecules of an Alkali Metal Vapour by a Molecular-Beam Method. L. C. Lewis. *Zeits. f. Physik*, 69. 11–12. *pp.* 786–809, *June* 13, 1931.—A molecular beam of Na, K or Li was passed through a non-homogeneous magnetic field, which deflected the magnetic atoms so that only the non-magnetic molecules kept the original direction of the beam. The intensity of the beam was measured by the Langmuir-Taylor method, and thus the equilibrium constant of the reaction $2\ Na \rightleftarrows Na_2$ was determined. Measurements with different oven temperatures gave the heats of dissociation. D_0, the heat of dissociation at 0° K., was found to be 16,800 ± 300 cal. for Na. The uncertainty was greater, perhaps ± 1000 cal., in the case of K and Li. H. N. A.

3332. Calculation of van der Waals Forces. H. Margenau. *Phys. Rev.* 37. *pp.* 1425–1430, *June* 1, 1931.—The general expression for the van der Waals energy arising from dipole interaction between atoms involves a summation over transition probabilities. These are in most cases difficult to calculate. It is here pointed out that since these transition probabilities obey the sum rule of Thomas and Kuhn, they may be evaluated in a manner which permits van der Waals forces to be calculated with good approximation, provided that the polarisability is known. The method is outlined and illustrated by application to two examples: Na and He. The result in the case of He is in very good agreement with that obtained by the variational method. AUTHOR.

3333. Molecular Weight Determination in the Gaseous State at Very Low Pressures. M. Volmer. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 863–873, 1931.—A new method of molecular weight determination is now described and tested by four examples, *viz.*, benzophenone, azobenzene, metaldehyde and quinhydrone. Full details of apparatus are included. H. H. Ho.

3334. Periodic Classification of the Elements. S. K. Mitra. *Phil. Mag.* 11. *pp.* 1201–1214, *June*, 1931.—Elements of the same period are placed in vertical columns instead of in horizontal rows, as in the ordinary periodic chart, and elements of the same group or family are in horizontal rows. The first horizontal line at the top of the chart shows the electronic levels or shells, the second line giving the quantum values of the orbits. The way in which the levels are filled up, in proceeding to consecutive atomic numbers, is indicated by drawing lines from element of atomic number N to that with N + 1. The result is that each horizontal row contains elements of similar electronic configuration, and similar chemical properties. The original paper should be consulted for details. H. N. A.

3335. Nuclear Moments. R. L. de Kronig and S. Frisch. *Phys. Zeits.* 32. *pp.* 457–472. *June* 15, 1931.—This paper consists of a theoretical outline, critical discussion and complete experimental summary of the investigation of phenomena which have recently found a satisfactory explanation by the assumption of a mechanical spin and magnetic moment of the atomic nucleus. Such phenomena are the hyperfine structures of spectral lines and the intensity alternations in the band spectra of diatomic molecules. Examples of the methods of determining nuclear moments from the experimental observations are given. A table of established nuclear moments is appended, and the paper concludes with an extensive Bibliography. J. E. K.

3336. The Neutron. R. M. Langer and N. Rosen. *Phys. Rev.* 37. *pp.* 1579–1582, *June* 15, 1931.—The writers point out that the postulation of the existence of the " neutron," a combination of an electron and a proton, of small size and low energy would be very useful in explaining a number of atomic and cosmic phenomena. They find that a mathematical treatment based on existing theory leads to indications of such a state, but no definite proof. AUTHORS.

3337. Nature of Single Bonds. A. Weissberger. *Zeits. f. phys. Chem.* 12. *Abt. B.* 6. *pp.* 408–412, *June*, 1931.—Reasons are given that in organic molecules directing groups attached by simple bonds arrange themselves rigidly in the positions of smallest symmetry. [See also Abstract 4074 (1930).] H. H. Ho.

3338. Structure of the Groups XO_3. J. C. Slater. *Phys. Rev.* 38. *pp.* 325–329, *July* 15, 1931.—The structure of such radicals as $(NO_3)^-$ on the one hand, $(ClO_3)^-$ on the other, is discussed on the basis of their being partly valence compounds, the oxygen being in the form of O^{-1} with one valence bond. The directional properties of the valence lead to a coplanar structure for the first type of radical, a pyramidal one for the second, as is observed. The energy relations are discussed, it is shown that the valence model will be bound in a stable structure, and that it is stabler, and hence nearer the real model than the purely ionic structure. AUTHOR.

3339. Dirac's Partial Differential Equations. N. Théodoresco. *Accad. Lincei, Atti*, 13. *pp.* 342–346, *March* 1, 1931.—Let $f(z) = u + iv$ be a continuous function of the variable $z = x + iy$. The condition $f(z)dz = 0$ for every closed contour inside a given region makes this function holomorphous. In this manner the theorem of Morera becomes independent of the operation $f'(z)$. The author extends this result to linear systems whose integrals are harmonic functions of any number of variables. E. E. F. d'A.

3340. Dirac's Equations and the Principle of Indeterminism. G. Racah. *Accad. Lincei, Atti*, 13. *pp.* 424–427, *March* 15, 1931.—Certain relativistic consequences of the principle of indeterminism are currently deduced by means of the calculus of operators applied to Dirac's relativistic equations. The author shows how to obtain the same result by applying the theory of characteristics to Dirac's equations and examining some properties of their integrals. A. D.

3341. Interpretation of Operators in Dirac's Wave Equation. N. R. Sen. *Indian Phys. Math. J.* 2. *pp.* 1–6, *March*, 1931.—Extends Schrödinger's interpretation of the Dirac matrices α_1, α_2 and α_3 [see Abstract 1104 (1931)] to α_4. This is shown to consist of a constant and an oscillatory part. The latter is investigated in detail and a geometrical interpretation is given. α_4 does not represent an independent idea or property, but can be described in terms of various field vectors. N. D.

3342. Structure of Field Equations of Material Waves. W. Alexandrow. *Zeits. f. Physik*, 68. 9–10. *pp.* 696–703, *April* 13, 1931.—In continuation of a previous paper [see Abstract 360 (1931)] the four-dimensional invariant tensorial form of the wave-mechanical equations are given which can replace the quasi-electromagnetic (or Dirac) equations which do not possess this property of invariance. The equations are consequently regarded as field equations. Besides the ordinary electromagnetic field the existence is established of a second field which has not previously been considered in the representation of material waves. H. L. B.

3343. Two-Quantum Processes. M. Göppert-Mayer. *Ann. d. Physik*, 9. 3. *pp.* 273–294, *May* 2, 1931.—Using Dirac's theory of dispersion, the probability of the simultaneous emission of two light-quanta is calculated. A definite probability is calculated that an excited atom will emit its energy of excitation in two random amounts (subject to the condition that the sum of the energies is constant). If light of a frequency less than the excitation frequency of the atom falls on it, a double emission can still occur. Conversely, the process is considered in which two quanta, the sum of whose frequencies is equal to the excitation frequency, collaborate to excite the atom. Further, the behaviour of an atom which can spontaneously emit light towards colliding particles is investigated. Lastly, an attempt is made to clear up anomalies in the intensities of spectral lines evoked by swift-electronic collisions on the basis of double processes. A. C. M.

3344. Quantum Theory of Radiation. L. Rosenfeld and J. Solomon. *J. de Physique et le Radium*, 2. *pp.* 139–147, *May*, 1931.—The authors seek to show that the difficulty of infinite energy at the absolute zero of radiation can be eliminated if we allow ourselves to be guided by the analogy with matter without modifying the conditions of quantising at present recognised, but by simply changing the form of the density of electromagnetic energy in a sense which is in agreement with the equations of Maxwell and with the principle of correspondence. The new variables used consist essentially of complex combinations of the electric field and the magnetic field. These modifications admit of a correct and particularly simple treatment of the question of fluctuations. H. L. B.

3345. Zero-Point Energy of a Hollow Space. G. Rumer. *Zeits. f. Physik*, 69. 9–10. *pp.* 664–665, *June* 8, 1931.—The author has previously shown [see Abstract 1212 (1931)] that it is possible to write the Maxwell equations for an empty space in a form similar to that of the Dirac equations. He now proposes a method of quantisation which avoids a zero-point energy, in the sense suspected by Jordan and Pauli, in the empty space. H. N. A.

3346. Secular Decrease of the Velocity of Light. T. Takéuchi. *Zeits. f. Physik*, 69. 11–12. *pp.* 857–858, *June* 13, 1931. *Phys. Math. Soc. Japan, Proc.* 13. *p.* 178, *June*, 1931. *In English.*—The author points out that the non-stationary line-element of the form $ds^2 = -e^{kt}(dx^2 + dy^2 + dz^2) + c^2dt^2$, which is practically of the same form as that occurring in Tolman's theory [see Abstract 3093 (1930)], requires the velocity of light to decrease slowly with time, but rather more slowly than the decrease shown by successive determinations of that velocity over the last fifty years, to which attention has been directed by Gheury de Bray.

J. S. G. T.

3347. The Uncertainty Principle. C. G. Darwin. *Science*, 73. *pp.* 653–660, *June* 19, 1931. *Paper delivered at the Lowell Inst., March,* 1931.—Difficulties associated with the dual interpretation of phenomena in terms of particle and wave respectively are discussed and resolved by reference to the uncertainty principle which is explained and illustrated in an easily readable manner. J. S. G. T.

3348. Correspondence between Classical and Wave Mechanics. K. K. Mukherjee. *Phys. Zeits.* 32. *pp.* 485–487, *June* 15, 1931.—Establishes the correspondence of Kar and Mukherjee's wave statistics [see Abstract 359 (1931)] with classical mechanics by deducing, in two different ways, an equation of the same form as the classical equation of motion of a particle. N. D.

3349. Five-Dimensional Formulation of the Wave Equation for the Electron. U. Kakinuma. *Phys. Math. Soc. Japan, Proc.* 13. *pp.* 183–188, *June,* 1931. *In English.*—The four-dimensional expression obtained [see Abstract 368 (1931)] for the line-element inside the electron at rest can be transformed into an expression in a five-dimensional pseudo-euclidean space. This corresponds to the state of the electron in the absence of an external field. When an external field is applied, the electron is set in motion and at the same time the space associated with it is subjected to a conformal transformation; that is to say, the space transformed is a so-called "conformally euclidean space." The chief advantage of immersing the usual four-dimensional space-time manifold in the five-dimensional space is that we are thus enabled to consider most conveniently and legitimately the conditions of the electron under the influence of external fields. It is also pointed out that our concepts of the five-dimensional space promise to be of service in giving a most plausible interpretation of the wave equation for the electron proposed by Dirac. AUTHOR.

3350. Pictorial Representations of the Electron Cloud for Hydrogen-like Atoms. H. E. White. *Phys. Rev.* 37. *pp.* 1416–1424, *June* 1, 1931.—It is well known that the solutions of the wave-equation for hydrogen-like atoms may be represented graphically by interpreting $\Psi\Psi^*$ as a probability density. The probability density factors $\Phi_m\Phi_m^* \cdot [\Theta_{m,l}]^2 \cdot [R_{n,l}]^2 = \Psi\Psi^*$ are represented graphically and briefly discussed and compared with the electron orbits of four classical models. Graphs for *s, p, d, f, g* and *h* electrons are given. An attempt to combine the probability density factors and form some graphical representation of $\Psi\Psi^*$ has resulted in the construction of a mechanical device or model, which, when photographed, gives very closely the desired result. Photographs for the magnetic states $m = 0, \pm 1, \pm 2, \pm 3, \ldots$ are given for 1*s*, 2*p*, 3*d*, 4*f*, 2*s*, 3*p*, 4*d*, 5*f*, 3*s*, 4*p* and 5*d* electrons. AUTHOR.

3351. Inverse-Cube Central Force Field in Quantum Mechanics. G. H. Shortley. *Phys. Rev.* 38. *pp.* 120–127, *July* 1, 1931.—The problem of the motion of a particle in an inverse-cube central force field is fully treated by quantum mechanics and the results compared with the classical theory. Taking the effective radial potential energy as S/r^2, although the solutions for negative energy for $0 \geq S \geq -h^2/32\pi^2\mu$ satisfy the usual boundary conditions, they cannot be admitted because the Hamiltonian is not Hermitian in these solutions. This corresponds to taking $(l + \frac{1}{2})^2$ in place of $l(l + 1)$ as the analogue of the square of the classical angular momentum. If we do this, we get a complete analogy between the classical and quantum mechanically allowed solutions, with no quantisation. The solutions involve Bessel functions of both real and imaginary orders with both real and imaginary arguments. AUTHOR.

3352. Quantum Treatment of the Benzene Problem. Part I. Electronic Configuration of Benzene and Some Related Compounds. E. Hückel. *Zeits. f. Physik,* 70. 3–4. *pp.* 204–286, *June* 27, 1931.—The special aromatic character of the electronic sextet in benzene and similar ring compounds is very fully discussed, and the behaviour mathematically

V.
19

investigated of *n* such related electrons in a plane ring C_nH_n. Two approximation methods are employed, *viz.*, (1) wherein the mutual action of *n* electrons in the field of *n* CH-groups is found by means of the Heitler-London procedure as applied to the hydrogen molecule and by Slater and Bloch to electrons in crystal lattices; (2) by the procedure of Bloch for the treatment of electrons in metal lattices. Heterocyclic rings, such as those of pyridine and pyrrol, are treated as rings of disturbed cyclic symmetry, and with certain simplifying assumptions the hydrobenzenes are considered on analogous lines. With respect to energy considerations, the theoretical results are in qualitative agreement with the experimental values. The paper is mainly mathematical, and the special function of the aromatic electronic sextet emphasised. H. H. Ho.

3353. Quantum Theory and Electron-Pair Bond. W. Heitler. *Phys. Rev.* 38. *pp.* 243–247, *July* 15, 1931.—It is shown for some simple examples that the stable molecular quantum state of a polyatomic system is nearly identical with a state by which there are built so many electron pairs between each pair of atoms, as the corresponding chemical formula shows. AUTHOR.

3354. Many-Electron Selection Rules. S. Goudsmit and L. Gropper. *Phys. Rev.* 38. *pp.* 225–236, *July* 15, 1931.—Selection rules for many-electron transitions are derived by taking into account the first order perturbed eigenfunctions. The perturbations considered are the electrostatic interactions between the pairs of electrons, and the spin-orbit interaction of each electron. It was found that the possibly occurring terms in the first order eigenfunction were narrowly limited, and that this limitation provided the selection rules as follows: No more than three electrons can jump at a time. (*a*) When three electrons jump all change their *n* by an arbitrary amount, one changes its *l* by ± 1, the others by δ and ϵ, $\delta + \epsilon$ being even. (*b*) When two electrons jump both can change their *n* arbitrarily, one changes its *l* by $\delta \pm 1$, the other one by ϵ. Breaking off the series expansion for $1/r_{FG}$ in the electrostatic interaction after the second term gives for δ and ϵ only the values 0, ± 1. The Heisenberg two-electron selection rule is therefore to be considered as a special case of (*b*). The Laporte rule is verified making use only of the properties of spherical harmonics. Qualitative rules have been derived to tell when many-electron transitions may be expected to be strong. The first order terms also cause anomalies in the intensities of one-electron transitions. AUTHORS.

3355. Zero Order Eigenfunctions. N. M. Gray and L. A. Wills. *Phys. Rev.* 38. *pp.* 248–254, *July* 15, 1931.—An elementary procedure is outlined for obtaining zero approximation eigenfunctions of many electron problems. The procedure allows a calculation of these functions as linear combinations of products of functions, each involving one electron only. The proper combination of products for one of the terms of highest multiplicity may, as a rule, be obtained by inspection; the remaining functions are obtained from this by the use of angular momentum operators. The " strong field " eigenfunctions for equivalent and non-equivalent electrons are obtained first, and from these are found the " weak field " eigenfunctions. The usual solution of the secular equation is unnecessary wherever the resultant states may be interpreted as having a definite and known kind of vector coupling (*e.g.*, Russell-Saunders, or (*jj*)). AUTHORS.

3356. Interaction Between Atoms with s-Electrons. N. Rosen. *Phys. Rev.* 38. *pp.* 255–276, *July* 15, 1931.—An attempt is made to systematise the general calculation of the interaction energy of a pair of atoms each of which has one or two equivalent *s*-electrons outside of closed shells. General expressions for this energy are set up in terms of certain integrals, and these integrals are evaluated for wave functions of Slater's type in terms of functions which are either tabulated or derivable from those in the accompanying tables. The method is applied to the calculation of some of the constants of a normal Na_2 molecule (which show fair agreement with the experimental values) and the repulsion energy of two normal helium atoms. AUTHOR.

3357. Low-Velocity Inelastic Collisions. C. Zener. *Phys. Rev.* 38. *pp.* 277–281, *July* 15, 1931.—The probability that a low-velocity collision be inelastic is shown to depend in a relatively simple manner upon three factors: the magnitude of the change in total internal energy, ΔE; the matrix element, with respect to the initial and final states, of the interaction energy at the closest distance of approach, W_{12}; and the "time of collision," τ, a function of the relative velocity and of the sharpness of the collision. An approximation to this probability is

$$P = [(2\pi W_{12}/h)\tau(1 + \epsilon_1\beta^{\epsilon_2})e^{-\epsilon_3\beta}]^2,$$

where $\beta = 2\pi\tau\Delta E/h$ and ϵ_1, ϵ_2, ϵ_3 are nearly unity, their precise values depending upon the characteristics of the particular collision. AUTHOR.

3358. Invariant Expression of the Law of Gravitation. J. le Roux. *Comptes Rendus,* 192. *pp.* 1439–1442, *June* 8, 1931.—An invariant integral expression, $\int\sqrt{2U}d\sigma$, derived from that proposed by Jacobi for the principle of least action $\int\sqrt{2U\Sigma m ds^2}$, and embodying suitable expressions for U and $d\sigma$, is shown to embrace all fundamental dynamical laws. J. S. G. T.

3359. Attraction of Homogeneous Ellipsoids. P. Dive. *Comptes Rendus,* 192. *pp.* 1443–1446, *June* 8, 1931.—An expression for the potential due to a homogeneous gravitating ellipsoid has been derived by Lagrange, Gauss and others. The author discusses the inverse problem to ascertain whether, assuming this potential expression to have positive values within a region R, there corresponds to it a homogeneous ellipsoid situate within that region. The analysis shows that there is always an unique solution. J. S. G. T.

3360. Static Problem in the Theory of Relativity. C. Racine. *Comptes Rendus,* 192. *pp.* 1533–1536, *June* 15, 1931.—The static gravitational field conforming to the metric proposed by Levi-Civita, *viz.*, $ds^2 = V^2dt^2 - d\sigma^2$, is discussed. J. S. G. T.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

3361. Mixing of Warm and Cold Saturated Air. K. Hidaka. *Imperial Marine Obs., Kobe, Japan, Mem.* 4. 2. *pp.* 53–73, *Feb.*, 1931. *In English.*—Using two equal masses of saturated air at different temperatures the final temperature and maximum amount of water vapour in the mixture and the amount of water vapour condensed are calculated, following a method similar to that of v. Bezold. The results are set out in tabular form for 5° C. steps in temperature from – 30° to 30° C. Tables are calculated for pressures 760, 700 and 600 mm. of Hg corresponding to equivalent heights of 0, 680 and 2000 m. respectively. The last of these heights corresponds approximately to that of the upper surface of the ordinary nimbus. R. S. R.

3362. Structure of a Warm Front. H. Berg. *Gerlands Beitr. z. Geophys.* 30. 1. 2. *pp.* 1–39, 1931.—Based on temperature observations obtained from thermograms of German and neighbouring stations and a series of ten upper air ascents made at Lindenberg the successive positions of a warm front over Germany have been obtained for the period Oct. 16–18, 1928. A mean rate of travel of 50 km./hr. is obtained. There is an extensive transitional region of rising temperature 900 km. in width. The structure of the upper air shows a surface of subsidence with an inclination to the ground of 1 : 1170, followed by a warm front, the inclination of which is different at different heights. At the ground the slope is 1 : 500, but it increases to 1 : 85, and the shape of the warm front surface is that of a flattened S, a view expressed previously by Ångstrom. The structure is shown by a diagram on which inversions, isothermal layers, potential and pseudopotential temperatures are indicated. The rise of temperature increases with the distance from the coast showing a connection between continentality and temperature-rise. The depth of the warm air is < 7000 m., a view supported by the results of ascents at Soesterberg. The greatest rise of temperature is found at a height of 1500 m. R. S. R.

3363. Relations between the Meteorological Conditions of the Troposphere and the Propagation of Radio Waves. I. Ranzi. *N. Cimento*, 8. *pp.* 98–106, *March*, 1931.—In the months of August and September, 1930, continuous observations were made on the reception of a wave of 42 m. placed on the external limit of the first zone of silence, in such a way as to be capable of revealing small variations in the extension of that zone. It was established that there exists a very exact correlation between the abnormal expansions of the first zone of silence and the invasions of equatorial air. It may be affirmed that the displacement of warm fronts in the troposphere is accompanied by changes in the ionosphere. J. J. S.

3364. Distribution of Ozone in the Atmosphere. D. Chalonge and E. Dubois. *Comptes Rendus*, 192. *pp.* 808–810, *March* 30, 1931.—Hitherto it has been supposed that the atmospheric ozone is concentrated in a layer at a high level with comparatively small thickness. Then it is easy to calculate *a priori* the law according to which must vary with the zenith distance ζ of the sun, the length x of the path across this layer of the solar rays observed. This law is represented by a family of curves

C depending on a parameter which is the altitude h of the layer. By a study of the solar spectrum a calculation may be made of the ratio of the intensities I and I′ at the ground of two radiations λ and λ' arriving from the sun. If their respective coefficients of absorption by the ozone are K and K′, then $x = \{-1/(K - K')\} \log I/I' + \text{const.}$ Whatever be the pair $\lambda\lambda'$ the same value of x must be obtained. The law of variation of x with ζ is determined when the variation of $\log I/I'$ is known experimentally. If this experimental curve $x = f(\zeta)$ can be made to coincide with one of the curves of the set C, the initial hypothesis is justified and the value of the altitude is found. Using a variation of this method, introduced by Cabannes and Dufay [see Abstract 2229 (1927)], the authors have made a determination of the altitude. This was carried out on October 7, 1930, at the observatory of the Pic du Midi under excellent atmospheric conditions. The results show that the distribution of the ozone is more complicated than was hitherto supposed, and is less continuous than was assumed, and is found also in appreciable quantity at relatively low altitudes.

J. J. S.

3365. Precision Sunshine Recorder. A. F. Dufton. *Journ. Sci. Instruments*, 8. *p.* 159, *May*, 1931.—An instrument is described for recording hours of sunshine with great precision consisting essentially of a U-tube, each limb of which ends in a cylindrical bulb of thin glass, the outside of which is copper-plated. One bulb is painted black, and the other, wound with a 10-ohm coil before being plated, is painted white. The U-tube forms a differential ether thermometer, and has three platinum contacts fused into it for the various electrical connections. When the sun shines, the upper contact in the black limb is opened and 50-cycle a.c. from 200-volt mains is fed through a 2-mfd. condenser, *via* the mercury in the tube, to an electromagnet which withdraws a stop action in a clock. When the mercury is further depressed to the extent of 1/32 in., the second contact opens. This causes the current to flow *via* the heating coil on the white bulb, which is thus maintained at practically the same temperature as the black bulb. The operation of the heating coil causes an almost imperceptible pulsation of the mercury surface of period about 5 sec. When the sun ceases to shine, the upper contact is rapidly made and the clock is stopped.

H. H. Ho.

3366. Photoelectric Sunshine Recorder. W. A. Thomson. *Canad. J. of Research*, 4. *pp.* 299–303, *March*, 1931.—A method is presented whereby an accurate record of the daily hours of bright sunshine is made by an electric clock, controlled, through a relay, by the intensity of the light incident upon the kathode of a suitably exposed photoelectric cell.

AUTHOR.

3367. Photoelectric Measurement and Photographic Recording of Daylight. W. A. Thomson. *Canad. J. of Research*, 4. *pp.* 559–564, *June*, 1931.—A method is described by which illumination intensities were measured by a photoelectric cell and galvanometer, and a continuous photographic record obtained of the variations of intensity over a period of time during which the ground was covered with snow. It was found that a remarkable increase in the illumination was caused by the presence of cloudiness with full sunshine. The percentage increase due to this condition in many cases was 20–30 %, and on one occasion it was as high as 40 %. When there was a cloud over the sun, with most of the sky clear, the decrease in illumination was found to vary up to 35 %, depending on the density of the cloud, and on many occasions it was observed that the increase in indirect illumination due to overhead cloudiness more than balanced the decrease of direct illumination when the sun was partly hidden. From this it is concluded that the intensity may be greater with the sun partly hidden than at the same time of day with a clear sky. AUTHOR.

3368. Uniform Temperature Compensation of Aneroids over the Whole Pressure Scale. A. Pfeiffer. *Zeits. f. Instrumentenk.* 51. *pp.* 307–311, *June,* 1931.—Two methods in use to obtain temperature compensation involve, (1) some air being left in the metallic box, or (2) a bimetallic strip to compensate the motion of the box. The principles underlying each are explained, and it is shown that true compensation holds only for a particular pressure. Two methods are then explained by which a bimetallic strip may be used in conjunction with the lever arm to obtain compensation over a pressure range such that the deformation of the aneroid is not too great. The deviations do not exceed 0·7 % for a pressure range 762–200 mm. Hg. R. S. R.

3369. Eleven-Year Thermal Wave at the Earth's Surface. F. Dilger. *Gerlands Beitr. z. Geophys.* 30. 1. 2. *pp.* 40–95, 1931.—Harmonic analysis is employed and for overlapping periods of eleven years the existence of the wave is shown by the regular increase of phase. The wave, however, is disturbed, there being jumps in phase amounting to even 100° and the amplitude oscillates strongly. For a given length of time the analysis for different stations provides a representation of the spatial distribution of the wave. The wave is produced in continental equatorial regions and propagated polewards under the different thermal conditions of the earth's surface and atmosphere. Its amplitude is least at the equator but increases polewards. The general picture is considered to hold only for the area investigated because phase and amplitude are altered by each disturbance. With these allowances agreement is obtained with the results of most other workers. The disturbances are supposed to be due to changes in the method of propagation. R. S. R.

3370. Transparency of the Sea and Visibility from a Height. G. Platania. *N. Cimento,* 8. *pp.* 152–156, *April,* 1931.—The transparency of the sea is measured by the depth to which a white disk can be sunk before ceasing to be visible, from boat-level. From a point at a height immediately above, the limit of visibility is the same. From a point not immediately above, the water-distance to be traversed by the rays would be too great, and the disk would not be visible; it would have to be raised somewhat. From a height, therefore, the field of the limits of visibility would be bowl-shaped, and would be flatter the higher the point of observation. The author traces the curves involved. A. D.

3371. Integration of Chrystal's Equation for the Seiches of the Two Scottish Lakes, Earn and Treig. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 4. *pp.* 227–239, *April,* 1931. *In French.*—Reference is made to the calculations by Chrystal and Wedderburn of the periods and nodes of Lochs Earn and Treig [see Abstract 256 (1906)] and the hydro-dynamical theory of seiches [see Abstract 1698 (1905)]. Each of the normal curves can be represented by another equation and the integration of the equation of the seiches is not difficult under the assumption made. The method is simpler while the exactitude of the results is comparable with those obtained by Chrystal's method. The method would apply to lakes having normal curves of parallel form and it is supposed that there are many other lakes of this kind among those of simple form frequently occurring in nature. R. S. R.

3372. Angle between the Wind and the Drift Current. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 4. *pp.* 241–270, *April,* 1931. *In English.*—The author seeks to establish the effect of the vertical gradient of the eddy viscosity coefficient (μ) on the deflection angle of the drift currents. He refers first to Ekman's theory concerning drift currents and the effects caused by the tangential stress of the wind, eddy viscosity and the earth's rotation [see Abstract 2010 (1906)], in which μ is assumed constant. Ekman found a deflection of 45° if the drift current velocity is small compared with that of the wind. Sverdrup introduced another factor due to forces between floating ice. The author takes the case of an ocean of infinite depth and area and obtains an expression for the drift angle, assuming that μ has a vertical gradient. After a discussion of the general relations between the stratification of the ocean water and μ, the theoretical relations are applied to the results obtained by Forch, Galle, Brennecke and Dinklage. Very good agreement results and it is hoped that further observations will confirm the theory. R. S. R.

3373. Report of the Twelfth Annual Meeting of American Geophysical Union. *Am. Geophys. Union, Trans.* [229 *pp*], 1931.

3374. Microphotometric Measures of the Line Hα at the Sun's Centre and Limb. B. Novàkovà. *Accad. Lincei, Atti,* 13. *pp.* 513–520, *April* 12, 1931.—Spectro-comparator measurements of the line Hα made at Arcetri showed that the relative position of $H\alpha_3$ and $H\alpha_2$ is unsymmetrical and that it varies. Microphotometric measures of the same plates made at Prague show that the wave-length of $H\alpha_3$ varies, and that the variation is correlated with the latitude, suggesting the influence of occasional perturbations, probably due to prominences, in the zones of the greatest solar activity. Variations in the height of the chromosphere, as observed at Arcetri in 1927–28, showed a similar correlation with latitude. The wave-lengths of certain atmospheric lines superposed upon Hα have also been determined from the microphotograms, and it appears that as $H\alpha_3$ and $H\alpha_2$ change their relative positions, the relative intensities must also change through the presence of these atmospheric lines, which, even when faint, must influence the intensity of $H\alpha_2r$. M. A. E.

3375. Pressure at Base of Chromosphere. D. H. Menzel. *Roy. Astron. Soc., M.N.* 91. *pp.* 628–652, *April,* 1931.—A critical study of Milne's theories of chromospheric equilibrium. The effective width of the absorption line, which was left unevaluated by Milne, is calculated. As a result, it has been found possible to calculate the partial pressure of Ca atoms at the base of an atmosphere fully supported by radiation-pressure, such as Milne supposes the chromosphere to be. This pressure comes out too small to make it possible for the reversing layer, with its large number of atomic collisions, to begin at the base of the chromosphere. Further, the density gradient in the chromosphere comes out as much too small, whilst the light emitted from the chromosphere should be ten times that observed. The general conclusion is that the chromosphere cannot be fully supported by radiation pressure. In case of a partially supported chromosphere, however, much the same objections can be urged against it.

Unless H atoms are extremely numerous, at the base of the chromosphere, Milne's theory of chromosphere and reversing layer cannot hold.
G. C. McV.

3376. Relationship between Solar Prominences and Coronal Forms. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 91. *pp.* 797–809, *May,* 1931.—A continuation of the author's previous work. He gives a table of the coronal forms in the sunspot period between September 21, 1922, and October 21, 1930; he defines the coronal types as "polar" (maximum solar activity), "equatorial" (minimum solar) and "intermediate"; he gives a diagram of the period, 1860–1940, for sunspots (areas and latitudes), prominences (frequency and latitudes) and the three coronal types. He shows that the prominence curves indicate (usually) two main zones in each hemisphere, and that the corona is of the "polar" type when the prominences exceed 60° in latitude in either or both hemispheres; that "equatorial" forms are exhibited when the zone or zones of prominences are in their lowest latitudes; that there is a different coronal form for increasing and for decreasing solar activity; and that generally the main features of the coronal types are reflected in the prominence distribution in latitude. He refers to Ludendorff's discussion of the degree of coronal ellipticity [see Abstract 432 (1929)] dependent on sunspot activity and cites Evershed and Bergstrand in support of his own contention of its dependence of prominence latitude. He gives an historical note concerning Respighi's work. A. S. D. M.

3377. Origin of Corona Lines. E. A. Hylleraas. *Zeits. f. Physik,* 69. 5–6. *pp.* 361–365, *May* 12, 1931.—Rosenthal's proposed interpretation of the coronal lines [see Abstract 3673 (1930)] as a helium spectrum with two excited electrons, is tested by calculations of the end term and the two constants in the current term of various Rydberg-Ritz series. It appears that Rosenthal's hypothesis must be rejected. Recent experimental work by Hopfield [see Abstract 1835 (1931)], in which a coronal line is obtained by discharges in oxygen, seems to provide the beginning of the solution of the problem. N. D.

3378. Correlation between Sunspots, Calcium Flocculi and the Sun's Radiation. K. Sotome. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 186–188, *May,* 1931. *In English.*—The author describes the instruments and the measurements of the plates and gives tables of the monthly mean values of the character figures for Ca flocculi in the years 1917–28 for the whole sun disc and for the central circle zone. He concludes that: (1) the activity of sunspots and Ca flocculi as well as the solar radiation have a fairly close relationship with each other; (2) the solar radiation has higher correlation with Ca flocculi than with sunspots; (3) the central zone has most effective influence on solar radiation; (4) Abbot's solar radiation constant appears to have a certain physical significance and, consequently, its variation corresponds really to that of the solar activity. A. S. D. M.

3379. Slow Contraction or Expansion of Fluid Sphere. Part II. L. H. Thomas. *Roy. Astron. Soc., M.N.* 91. *pp.* 619–628, *April,* 1931.—The stability of a fluid sphere which slowly contracts or expands with conduction of heat and internal generation of energy is studied. There are three groups of conditions of stability. Firstly, the dynamical condition that the dynamical energy should be a true minimum. Secondly, the thermodynamical conditions governing the value of the entropy. It is shown that necessary conditions of this type are difficult to apply, but a comparatively simple sufficient condition is obtained. Thirdly, conditions which control small variations from the expected slow change when thermodynamical and dynamical stability both exist. The equations giving these variations are complicated and no simple criterion of stability can be found. [See also Abstract 1132 (1931)]. G. C. McV.

3380. Emden's Differential Equation. E. Hopf. *Roy. Astron. Soc., M.N.* 91. *pp.* 653–663, *April,* 1931.—The author gives simple proofs of R. H. Fowler's theorems [see Abstract 1142 (1931)] regarding the arrangement and asymptotic expansions of the various types of solution of Emden's equation. The basis of the method is the reduction of Emden's equation to a single first-order equation. G. C. McV.

3381. Theoretical Contours of Absorption Lines. Part II. A. Pannekoek. *Roy. Astron. Soc., M.N.* 91. *pp.* 519–531, *March,* 1931.—In the first paper on this subject [see Abstract 1146 (1931)] the author treated the case of an atmosphere of constant composition. In the present paper two other extreme cases are discussed: (1) when the concentration of ionised atoms increases proportionally to the pressure, and (2) when the concentration decreases at a rate inversely proportional to the pressure. It is shown that in case (1) the contour lines at medium residual intensity are less steep than in case (2), and an explanation is given. To compute the relative number of electrons in a stellar atmosphere it is necessary to know the elementary composition of the atmosphere, that is, the fractional abundance of each kind of atoms. By making certain simple qualitative assumptions about the predominance of hydrogen and the relatively small percentage of metal atoms in the whole mass it is possible to get an estimate for the electron abundance in different classes of stars. The author illustrates his formulæ by considering the behaviour of the Ca^+ lines H and K. H. L. B.

3382. Effective Interferometric Wave-Length. M. Maggini. *Accad. Lincei, Atti,* 13. *pp.* 358–361, *March* 1, 1931.—The effective interferometric wave-length is that monochromatic wave-length which, on being substituted for the complex light of a source, say a star, will give the same system of fringes in an interferometer. The author gives a method of determining this by a combination of a spectroscope with an interferometer. Applications are made to astronomical measurements. A. D.

3383. Wave-Lengths of Oxygen and Nitrogen Lines in the Stellar Region. C. S. Beals. *Roy. Astron. Soc., M.N.* 91. *pp.* 531–537, *March,* 1931.—The results are given of an investigation conducted for the purpose of obtaining precise laboratory values of the wave-lengths of oxygen and nitrogen lines which occur in the ordinary stellar region of observation. The values recorded are compared with those obtained elsewhere. H. L. B.

3384. Luminosity Curve of Early B Stars. B. P. Gerasimovič. *Roy. Astron. Soc., M.N.* 91. *pp.* 537–548, *March,* 1931.—A simple and practical method of deriving the luminosity curve from the frequency curves of τ-components and peculiar radial velocities has recently been given by Strömberg. The author describes briefly the general principle of this new method and indicates the difficulties of applying the method to the B-type stars as compared with the K and M stars, and then obtains results for certain groups of B stars. H. L. B.

3385. Mean Light-Curves of Long-Period Variable Stars. Part III. R. Trianguli. A. A. Nijland. *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 654–659, 1931.—This discussion is based upon 671 observations made between the years 1905 and 1931. The star has a period of 265 days, and the extreme limits of variation in magnitude are $11^m{\cdot}61$ and $5^m{\cdot}97$, but both minima and maxima frequently differ from the mean in a quite irregular way. The mean curve is perfectly smooth. M. A. E.

3386. Spectrophotometry and Atmospheric Extinction. P. Rossier. *Arch. des Sciences,* 13. *pp.* 81–96, *March–April,* 1931.—A preliminary attempt to estimate the magnitude of a star from the length of its stellar spectogram, using an objective prism. The author describes the instrument (Schaer objective prism with a Boulenger objective), the plates (Cappelli-blu) and developer, exposure and type of star (A_0) examined. A spectro-comparator is used for the measurement. The length of the spectrogram varies inversely with the stellar magnitude. The results have not proved as encouraging as those by Tiercy, who measured spectrograms from Arcetri; perhaps because of the inferior atmospheric conditions at Geneva, partly because Tiercy used a mirror and not an objective. As regards atmospheric extinction, most investigators have considered visual rays, but, photographically, account must be taken of absorption of ultra-violet rays by water vapour. The author finds that increase of 1 mm. in water-vapour tension augments zenithal extinction at the place of observation for photographic rays by a quantity near to 0·09 magnitude. A. S. D. M.

3387. Parallax of Nova Pictoris. H. S. Jones. *Roy. Astron. Soc., M.N.* 91. *pp.* 608–619, *April,* 1931.—A trigonometrical determination of the parallax of Nova Pictoris, obtained during 1928, yielded the result, $-0{\cdot}009'' \pm 0{\cdot}007''$, for the absolute parallax. By correlating the increase in brightness with the rate of expansion of the star given by the spectroscopic data, a parallax of $0{\cdot}0015''$ was obtained. It was assumed that the nova expanded up to the time of the first maximum. The value of the parallax is independent of the unknown effective temperature of the star before outburst. Observations of the nebulosity surrounding the star tend to confirm this value. The radius of the nova expanded from 118 times to 384 times the sun's radius in the course of the outburst.
G. C. McV.

3388. Spectrum of Nova Pictoris, 1926–1931. H. S. Jones. *Roy. Astron. Soc., M.N.* 91. *pp.* 777–794, *May,* 1931.—The author supplements previous work [see Abstract 2308 (1926)]. When the Cape observations ended on March 13, 1926, the nova spectrum consisted almost entirely of emission bands. Tables are given of the spectrum features for 1926 (March–October), for 1928 and 1931. He finds: In 1926, strong Hα and Hβ (hydrogen); λ4686 (ionised helium) was not seen up to March 13th, but was the most prominent line on March 15th, and was subsequently somewhat variable; ionised iron was characterised both by ordinary and by (stronger) " forbidden " bands [see following Abstract]; there were both nebular and other emissions. In 1928, there was great reduction in neutral helium line-intensity; marked strengthening of λ4686 and weakening of λλ4472, 5876, all indicating a higher degree of ionisation than in 1926; λ6087 was markedly strengthened; λ5721 (seen on only one plate on September 7, 1926) was in 1928 not much inferior to Hα, and has not been observed in either nebulæ or Wolf-Rayet stars. In 1931 only one plate was taken (February 21st, 22nd, 23rd) and is compared with the one taken on April 25, 1928. It shows equal strength in the continuous spectrum; a decrease in the Balmer series line intensity; weakening of λ4686, so that λ6087 has become the most prominent line; λ5722 remains of same intensity as Hα as in 1928; the nebular lines, N_1 and N_2, and the neutral helium lines are absent (as in the case of previous novæ); only λ5411 of the Pickering series appears to remain, showing a rapid decrease towards the violet. The author concludes that the 1931 spectrum resembles strongly that of the Wolf-Rayet stars; the emissions, Hα, and λλ5723, 6088, are the most prominent features, and that Nova Pictoris has probably attained its permanent spectrum in 1931. A. S. D. M.

3389. Spectrum of η Carinæ. H. S. Jones. *Roy. Astron. Soc., M.N.* 91. *pp.* 794–797, *May,* 1931.—Merrill has shown that some of the lines of η Carinæ are due to " forbidden " lines of ionised iron [see Abstract 2649 (1928)], and this becomes important in view of the fact that the same " forbidden " emission lines were seen at one stage in Nova Pictoris (in 1926) [see preceding Abstract]. The author has measured a plate of η Carinæ, taken at the Union Observatory, Johannesburg, on April 30, 1919, and gives a table of the derived wave-lengths, estimated intensities (on an arbitrary scale), suggested identifications, and multiplet designations for the spectral region λ3939 to Hα. A. S. D. M.

3390. Algol and Stellar Rotation. O. Struve and C. T. Elvey. *Roy. Astron. Soc., M.N.* 91. *pp.* 663–675, *April,* 1931.—In former papers [see Abstract 1820 (1929)] it has been shown that the contours of the very wide and hazy absorption lines seen in the spectra of many early-type stars may be interpreted as evidence of axial rotation. It has been shown by others that in many eclipsing variables the spectrum lines are unsymmetrical at the time of partial eclipse, when one limb of the brighter star is covered, and this forms another independent proof of rotation. A detailed investigation has now been made of the changing contour of the Mg line λ4481 in Algol, and this gives a value for the rotational velocity identical with that obtained from the limb-effect. There is an unexplained tendency for the total absorbed energy in the line to vary with the phase. An analysis of the spectra of giants and dwarfs, both single and double, indicates that in early spectral types rapid axial rotation is about as frequent in single stars as in spectroscopic binaries, but that in later types rapid rotation occurs only in close binaries. This may have a bearing on the problem of the origin of double stars. M. A. E.

3391. Motion of Stars in Nebulous Matter. K. Hirayama. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 182–185, *May,* 1931. *In English.*—An account of the capture theory of stars, to explain the origins of binaries and clusters. The author considers first a star passing through a spherical cloud (*i.e.*, a nebula, bright or dark, which has spherical symmetry) and uses the two-body motion relation $(a^{-1} = 2 . r^{-1} - v^2 . m^{-1})$. He finds for the star's passage: (1) without impact, that the integrated effect is zero, so long as the cloud maintains spherical symmetry; and (2) with impact, that the motion becomes more elliptic; the variation is secular, and the integrated effect increases with the time supposing the impacts to occur in succession; if the star's original motion be slightly hyperbolic, it may be varied to elliptic by such succession, and this elliptic motion be continued after egress, so that the transit of the star is repeated until it is captured; if the cloud has had no systematic angular velocity it will share the angular motion of the star relative to the cloud. With such a small cloud he suggests the formation of a system like our sun's; with a large and dense cloud two or more stars may be captured, and in the spherical cloud the motion of binary stars is characterised by simultaneous decreases of the semi-major axis and the eccentricity of the relative orbit, together with increases of the masses. Eventually a huge spherical cloud may capture many stars, large and small, the cloud itself being absorbed by them, thus forming a globular cluster; if the cloud be aspherical, the cluster will be an open one. A. S. D. M.

3392. Space-Density of Matter in Globular Clusters. A. Kipper. *Zeits. f. Astrophysik*, 2. 3. *pp.* 214–216, *April* 1, 1931.—A globular cluster is treated as a polytrope of index 5, and a formula is derived connecting space-density and velocities of the stars in the cluster. If the velocities reported by various observers are correct, the density is calculated as 10^4 sun-masses per cubic parsec; if instead a more plausible density is assumed, the real velocities must be too small to measure. R. d'E. A.

3393. Absorbing Clouds. H. Müller. *Zeits. f. Astrophysik*, 2. 4. *pp.* 254–288, *April* 23, 1931.—The variation, with galactic longitude, of Seares' tabulated star-counts can be explained by the assumption that the sun is eccentrically situated in the galaxy, together with the accepted existence of absorbing clouds in Ophiuchus and Taurus. On the assumption that there is no absorption in other regions the true stellar distribution-function (between ± 20° galactic latitude) can be obtained; the extension of the galaxy is about 1½ times that previously found. The absorbing clouds in Taurus and Ophiuchus are then found to be about 200 parsecs distant, with an average absorption of about one magnitude. Parallactic motions of stars brighter than the twelfth magnitude are larger than normal in the Taurus region, as is to be expected. The centre of the Ophiuchus cloud shows considerable extension in the direction away from the sun, with strong concentrations at about 160 and 1000 parsecs distance and a total absorption of about 3½ magnitudes. The cloud may even be connected with the Taurus cloud, the sun lying in the connecting region. The dark gap in the Milky Way is scarcely noticeable in star-counts down to the 18th magnitude, so that the (visible) Milky Way is probably due mainly to still fainter stars. If absorption is responsible for this gap, the cloud must be at a very great distance. R. d'E. A.

3394. Raffety Bands and the Spectrum of Comets. F. Baldet. *Comptes Rendus*, 192. *pp.* 1531–1533, *June* 15, 1931.—A comparison of wave-lengths in the Raffety bands of cometary spectra [see Abstract 2213 (1931)] and those observed by Grenat in the oxy-acetylene blowpipe flame [see following Abstract] leads the author to conclude that the origin of the Raffety bands is still unknown. J. S. G. T.

3395. Identification of the Raffety Spectrum in Cometary Spectra. H. Grenat. *Comptes Rendus*, 192. *pp.* 1553–1555, *June* 15, 1931.—Lines in the Raffety band spectrum, 4025·300–4119·688 Å., developed in the oxy-acetylene blowpipe flame are tabulated. From analogy with the bands 3628 and 3900 Å., the Raffety spectrum is attributed to hydrocarbon vapour. New bands observed with heads at 4108·07, 4148·48 and 4770·36 Å., are probably attributable to carbon or one of its compounds with oxygen. [See also preceding Abstract.] J. S. G. T.

3396. Distance to Galactic Centre. P. van de Kamp. *Astron. J.* 41. *No.* 957. *pp.* 81–83, *June* 5, 1931.—The author investigates the effect on the distance to the galactic centre of the general (photographic) galactic absorption of light determined by Trumpler and the author as $0^{\text{m}}\cdot 67$ per 1000 parsecs [see Abstract 417 (1931)] and by Bottlinger and Schneller as 2^{m} per 1000 parsecs [see Abstract 787 (1931)]. This has been determined: (1) by Shapley from the system of globular clusters as 167,000 parsecs; (2) by Shapley and (Miss) Swope [see Abstract 1122 (1929)] from the cluster-type variables in Harvard Milky Way Field 185 as 14,400 parsecs; (3) by Lindblad's and Oorts' hypothesis of galactic rotation as 7000 and 11,000 parsecs (Oort), 6500 parsecs (Lindblad) and 8800 parsecs (Wilson and Raymond). The author computes these afresh on the basis: (*a*) of ignoring any absorption; (*b*) of Trumpler's constant; (*c*) of Bottlinger and Schneller's constant, and where applicable using (*x*) Pickering's pole of the galaxy or (*y*) van Rhijn's pole. He finds for the distance to the galactic centre on (1*a*) 16,700 parsecs, (1*b*) 13,700 and (1*c*) 9700; on (2*a*) 14,400 parsecs, (2*bx*) 11,600, (2*by*) 12,500; (2*cx*) 7400, (2*cy*) 9400; on (3) the effect of a galactic absorption on the distance R is negligible considering the present uncertainties in the constants. The author considers that a distance of about 12,000 parsecs (roughly 40,000 light years) is a fair compromise between the various values stated above. [See also following Abstract.] A. S. D. M.

3397. Thickness of Galactic Absorbing Layer. P. van de Kamp. *Astron. J.* 41. *No.* 957. *pp.* 84–85, *June* 5, 1931.—The author uses Öhman's observations so as to make an evaluation of the thickness of the absorbing layer. For certain stars of types B, A and F, Öhman has obtained a colour equivalent (C) which is the magnitude difference between λ3912 and λ4415. The colour of the B stars derived from the intensity of the H lines together with their colour increases with increasing galactic latitude, and the author finds for B0–B5 stars, within 2200 parsecs and between galactic latitudes ± 10°, an absorption of $0^{\text{m}}\cdot 19$ per 1000 parsecs (after correcting for Trumpler's photographic absorption constant) for λ3912 relative to λ4415. The corresponding equivalent of a B star not affected by selective absorption is $+ 0^{\text{m}}\cdot 04$. For stars within 1000 parsecs, the values are about $0^{\text{m}}\cdot 30$ for the absorption coefficient, and a corresponding value of $- 0^{\text{m}}\cdot 02$ for the B stars not affected by a selective absorption. For five B stars with galactic latitude $> 10°$ and more than 200 parsecs distant from the galactic plane, the author forms two equations of condition: $0\cdot 19 \operatorname{cosec} b\,.\,h\,.\,(2000)^{-1} = \mathrm{C} - 0^{\text{m}}\cdot 04$ and $0\cdot 30 \operatorname{cosec} b\,.\,h\,.\,(2000)^{-1} = \mathrm{C} + 0^{\text{m}}\cdot 02$, where b is the galactic latitude and h is the thickness of the absorbing layer, and finds that the resulting values of h are not very different in the two solutions, and he adopts $h = 210 \pm 40$ parsecs. [See also preceding Abstract.] A. S. D. M.

3398. Distribution of Eccentricities and Mean Anomalies of Double Visual Long-Period Stars with Orbits not yet Calculated. D. Barbier. *Comptes Rendus*, 192. *pp.* 1635–1638, *June* 22, 1931.—Russell showed that for a group of pairs of unknown orbits a mean value of the eccentricity can be obtained statistically. The author obtains a function of the distribution of eccentricities and mean anomalies. The results are applied to 111 couples of the Greenwich catalogue. The distribution is not uniform, the maximum of the curve being near 120°, the reasons for which are given. The order of magnitude of the period of stars is found by a formula for 38 couples of known orbits with periods > 100 years and $\log_{10} P = 2 \cdot 32$ instead of $2 \cdot 28$, the true value. For stars with the author's statistics $\log_{10} P = 2 \cdot 86$ and the period about 700 years. Russell found for a period of 2000 years a mean-square eccentricity of $0 \cdot 61$, and this is probably too small on account of insufficiency of the hypothesis on the distribution of mean anomalies. R. S. R.

3399. Periodicity in Series of Related Terms. G. Walker. *Roy. Soc., Proc.* 131. *pp.* 518–532, *June* 3, 1931.—The paper forms extension of an investigation by Yule [see Abstract 2837 (1927)]. Mathematical analysis shows that if Yule's equation defining the relationship between successive undisturbed terms of the *u* series is $u_u = g_1 u_{x-1} + g_2 u_{x-2} + \cdots + g_s u_{x-s}$, then provided *u* is large a similar equation holds very approximately between successive values of r_p, the correlation coefficient between terms of *u* separated by *p* intervals, *i.e.*, $r_x = g_1 r_{x-1} + g_2 r_{x-2} + \cdots + g_s r_{x-s}$. Thus the graph expressing the r_p's, which is much smoother than that of the *u*'s, may be used to read off the character of the natural period of the *u*'s; further various relationships are found between the amplitude of the corresponding terms in the Fourier periods and those of the correlation coefficients. The analysis is illustrated by applying it to the quarterly values of pressure at Port Darwin, a key-centre of world weather, which proves to have a strong persistence and to show evidence of not very strongly developed periods of about 34½ months and of about 4 times this length or 11½ years; the series of data is not long enough to settle whether the former oscillations are damped and are free oscillations, but the latter appear to be imposed from without and are presumably solar in origin. R. S. R.

3400. Multiplets in Stellar Spectra. G. Shajn. *Roy. Astron. Soc., M.N.* 91. *pp.* 675–697, *April*, 1931.—The study of multiplet intensities in stellar spectra is an urgent problem. The theoretical intensities given by the quantum theory agree with observations of laboratory emission spectra, but no experimental tests have been made of absorption spectra. From observations of doublets of Na and Ca^+ and triplets of Mg, it appears that the most striking feature is the very small difference in central intensities of the lines belonging to the same stellar multiplet, the contrast being much less than that observed in laboratory emission spectra, or predicted by the formulæ. A small but real difference exists between the same multiplets in individual stars of the same spectral class, yet there is a constancy in the intensity ratio of lines within a multiplet along the whole spectral sequence. The ratio of total line absorptions of H and K deviates from that predicted by theory for the case of damping radiation. The ratio of emission lines in H and K in certain late-type stars shows a somewhat closer approximation to that observed in laboratory emission spectra, but it remains large. It is shown that with certain assumptions the observed facts may be accounted for by Eddington's model for absorption lines. The data are discussed in the light of ionisation theory, and comparisons are made between the observed intensity curves and the theoretical curves which give the atomic fractional concentrations. M. A. E.

LIGHT.

3401. Light Absorption in a Simple Ionic Lattice and Electrical Aspects of the Latent Image. R. Hilsch and R. W. Pohl. *Zeits. f. Physik,* 68. 11–12. *pp.* 721–734, *April* 20, 1931.—Crystalline KBr has a sharp absorption peak at 2030 Å. and is coloured in the process, colour-centres or "latent image" centres being produced. These are destroyed and the crystal bleached by subsequent exposure to longer wave-lengths (maximum absorption at about 6000 Å.). A carefully purified specimen of KBr, *in vacuo* between graphite electrodes, was exposed successively to "colouring" and "bleaching" light, and the internal electric fields studied by a sensitive fibre-electrometer. It is concluded that the primary effect in the production of the latent image by the "colouring" light is the transfer of an electron from anion to kation; exposure to the "bleaching" light causes the destruction of the latent image with an electron displacement, through a distance which is independent of the wave-length of the light producing the latent image and which can be computed from the actual internal charge observed. It is shown that a latent image may be produced even by light of wave-length 4000 Å. and upwards. In this case the absorption constant determined electrically is $K = 5 \times 10^{-7}\text{mm.}^{-1}$, employing the value $K = 0{\cdot}36 \text{ mm.}^{-1}$ at 2030 Å. obtained optically by Smakula [see Abstract 92 (1931)]; such extremely low values of the absorption constant are much smaller than could be measured by purely optical photometry. At long wave-lengths it is impossible to measure separately the "colouring" and "bleaching" effects, since both proceed simultaneously. **Errata**, *ibid.* 69. 7–8. *p.* 564, May 28, 1931. L. V. C.

3402. Dictionary of Colour. M. R. Paul. *J.O.S.A.* 21. *pp.* 358–360, *June,* 1931.—Describes a colour chart containing about 7000 samples. The colours are divided into seven main regions and each of these has eight complete colour plates devoted to it. These eight plates contain the same colours but with increasing amounts of grey until the colours approach black. In each plate there are 144 patches, *viz.*, 12 different hues within the colour range covered, each hue being presented in 12 degrees of saturation. Names are attached to the individual patches and these represent, as nearly as can be ascertained, all the colour names that are in reasonably current use in the English language. Over 3400 of these names are given in the Index. A section of the Dictionary is devoted to detailed colour notes, a history of colour standardisation, textile names, traditional names, scientific names, terms used in literature, etc. J. W. T. W.

3403. Colour Measurement of Paints. G. F. A. Stutz. *J.O.S.A.* 21. *pp.* 323–335, *June,* 1931.—Gives first the specification prepared by the American Society for Testing Materials. This includes a spectrophotometric determination of the reflected light under stated conditions of illumination, *viz.*, diffuse or unidirectional. If the latter, the angle of incidence is to be stated. In any case the manner and angle of viewing is to be described. The author considers that, in addition to the spectral reflection curve, the amount of specularly reflected light (the gloss) should be determined, as well as the total (integrated) reflectance. For white or

V. 19

nearly white paints the ordinary spectrophotometer is not entirely suitable, and some instrument in which the light undergoes multiple reflections should be used. The Pfund colorimeter is suitable for this purpose. For the gloss measurements the Pfund glossmeter may be used. This instrument is not absolute, but determines the gloss relative to a standard such as a piece of polished glass. There is at present no entirely satisfactory instrument for the measurement of the total reflectance. J. W. T. W.

3404. Colour Measurements in the Dyestuff Industry. C. Z. Draves. *J.O.S.A.* 21. *pp.* 336–346, *June*, 1931.—The author points out the many directions in which it is preferable to employ visual inspection of dyestuffs in preference to spectrophotometric methods. He describes a test in which slight admixtures of a red dye could be more readily detected by eye. Further, he points out that the expert dyer who knows the working properties of his dyes can match shades more quickly and satisfactorily, by means of visual inspection of his dyeings, than he can with spectral reflection measurements. Further, by using a north light, an artificial daylight lamp and an ordinary artificial light, he can tell quickly if his dyeing matches the submitted sample of dyed goods under different kinds of illumination. The spectrophotometer has a great field of usefulness in determining the degree of change undergone by dyed fabrics when subjected to destructive agencies such as light and washing. Here an absolute measurement is needed, and not a match with some available sample. J. W. T. W.

3405. Colour Measurement in the Paper Industry. W. B. van Arsdel. *J.O.S.A.* 21. *pp.* 347–357, *June*, 1931.—Until recently, colour grading of pulps and papers has been carried out by ordinary visual inspection and it is found that the day-to-day repetition achieved by a single individual of long experience is remarkably good. Generally, the bleached wood pulps differ from white only by varying small amounts of yellow. Ten samples were found to have dominant wave-lengths, covering the very narrow range 576 to 579 $m\mu$, whilst the purities ranged from 0·04 to 0·2. It is clear, therefore, that all the points representing the range of colours usually met with lie inside a very small area near the centre of the colour triangle. In 1916 comparison standards were established by specifying six mixtures of plaster of Paris with varying amounts of potassium chromate (0 to 0·3 %). This arrangement was modified later by using wheels of plaster of Paris having small sectors of various angles made of zinc chromate. The wheels were rotated to effect the mixture of the yellow with the white. The samples were compared with the rotating wheels, both being viewed by light from a Macbeth daylight unit. It was found that the colour number assigned to a given sample of pulp by this method correlated well with the percentage purity as determined by colorimetry. It was also found that a trained observer could just detect a difference of 0·9 % purity in nearly white samples. A specification of pulp should include both brightness and colour. If the pulp be yellowish, blue must be added to neutralise this in the paper and so the reflection factor is reduced. The author suggests that the specification should be the highest reflection factor of a neutral (colourless) paper which can be made from the pulp considered. J. W. T. W.

3406. Reflection by Water and Ice in the Infra-Red. M. Weingeroff. *Zeits. f. Physik*, 70. 1–2. *pp.* 104–108, *June* 20, 1931.—Reflecting power in the infra-red of water between 11 and 18 μ and of ice between 6 and 15·8 μ is measured. The dependence of the reflecting power of water on the wave-length can be brought into agreement with the Debye theory of liquid dielectrics. The variation of reflecting power with wave-lengths in the case of ice suggests that there is a residual-ray vibration at about 14 μ. A. C. M.

3407. Transmission of Light Through Fog. H. G. Houghton. *Phys. Rev.* 38. *pp.* 152–158, *July* 1, 1931.—Measurements were made on the transmission of visible light through artificial fog which was produced by condensing low-pressure steam in a chamber 300 cm. long and about 25 cm. square. Curves for several fog densities were obtained and they all indicated a definite maximum transmission at about 0·490 μ. The relation between the transmission of light through fog and the fog density was found to be practically linear. The maxima obtained are not in agreement with the results of other investigators but a comparison of the particle sizes of the fogs used in this work with those of the fogs used by others leads to the conclusion that the shape of the transmission curve is dependent on the particular particle size or sizes of the fog on which the measurements are made. [See also following Abstract.] AUTHOR.

3408. Transmission of Light Through Fog. J. A. Stratton and H. G. Houghton. *Phys. Rev.* 38. *pp.* 159–165, *July* 1, 1931.—This theoretical investigation was undertaken in an attempt to explain some unexpected experimental results which are described in detail in another paper [see preceding Abstract]. The fog droplets are assumed to be dielectric spheres with an index of refraction of 1·33 and the development is based on the work of Mie and Debye on the pressure of light and the colours of colloidal solutions. The results show that the particle size of the fog is a controlling factor in the transmission characteristics of the fog. By assuming the appropriate particle size a theoretical transmission curve is obtained which closely corresponds to the experimental data. In conclusion, it is pointed out that the King formula is not applicable to the scattering of light by particles as large as fog drops. AUTHORS.

3409. Residual-Ray Investigations in the Spectral Region Between 20 and 40 μ. J. Strong. *Phys. Rev.* 37. *pp.* 1565–1572, *June* 15, 1931.—An apparatus is described which is convenient for studying the optical properties of substances with residual rays (*Reststrahlen*) having wave-lengths from 6 to 150 μ. A vibrationless support is described, the essential features of which are copied from the design of R. Müller [see Abstract 2066 (1929)], but the construction is simplified. The transmission of several gases was studied with residual rays having wave-lengths 20 to 33 μ. SO_2 shows strong absorption at 20.75 μ. The reflectivity of SO_2 was tested and found to be zero at both 20.75 μ and 8.7 μ where it has strong absorption bands. Gas absorptions from 20 to 33 μ are compared with the Raman indications. Transmissivities and reflectivities of various materials are given for the spectral region 20 to 33 μ. β-MgO was found to have a residual ray near 23 μ. Potassium iodide was found to be transparent to wave-lengths greater than 33 μ. AUTHOR.

3410. Reflection Power of Metals in Thin Layers for the Infra-Red. R. B. Barnes and M. Czerny. *Phys. Rev.* 38. *pp.* 338–345, *July* 15, 1931.—The reflection power of metals for the infra-red and the visible spectra has been studied with special regard to the dependence of

R upon the thickness of the reflecting layer. A new equation governing this relation has been developed. AUTHORS.

3411. Reflecting Power and Grating Efficiency in the Extreme Ultra-Violet. H. M. O'Bryan. *Phys. Rev.* 38. *pp.* 32–40, *July* 1, 1931.—A concave glass grating of 1 m. radius of curvature with 30,000 lines to the inch has been selected to make quantitative measurements of grating efficiencies and reflecting powers between 200 Å. and 1000 Å. A water-cooled vacuum spark between tungsten electrodes made an extremely intense and sufficiently constant source. Small plane gratings were crossed with the concave grating so that the efficiency of the small grating could be determined for several wave-lengths and all angles of incidence. The results show that gratings which are efficient at normal incidence are not at all suitable near grazing incidence. The reflecting powers of glass and gold mirrors at 388 Å. and 770 Å. have been measured for all angles of incidence. The values of the reflecting power of glass for several angles of incidence and wave-lengths from 50 Å. to 4800 Å. are given. The influence of reflecting power, groove form, and surface smoothness on the efficiency of a grating are discussed. AUTHOR.

3412. Lithium Hydride. H. Bode. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 99–104, *June*, 1931.—The density and refractive index of lithium hydride are found to be: $d = 0\cdot705 \pm 0\cdot02$ and $n_D = 1\cdot615$.
F. J. W.

3413. Theory of Anisotropic Liquids. Parts XIII, XIV and XV. C. W. Oseen. *Arkiv. f. Mat., Astron., och Fysik, Stockholm*, 22*A*. No. 17. *pp.* 1–12, No. 18. *pp.* 1–19, No. 19. *pp.* 1–23, 1931. *In German.*—Part XIII considers the optical activity of the drilled structure; Part XIV deals with possible structures of nematic substances; and Part XV investigates the geometrical optics of nematic bodies. All the papers are entirely mathematical. H. H. Ho.

3414. Mutarotation and Rotatory Dispersion of Galactonic Acid and Lactone. T. M. Lowry and V. K. Krieble. *Zeits. f. phys. Chem. Bodenstein Festband, pp.* 881–889, 1931. *In English.*—The γ-lactone of galactonic acid melts at 112° and has a specific rotation $[\alpha]^{20}_{5461} = -93\cdot1°$. The simple rotatory dispersion of the lactone can be expressed by the dispersion-formula: $\alpha/\alpha_{5461} = 0\cdot2389(\lambda^2 - 0\cdot0586)$. The dispersion-constant corresponds with a characteristic absorption at a wave-length 2420 Å. as compared with 1520 and 1620 Å. for α and β methylglucosides. The sodium salt of galactonic acid is dextrorotatory and gives anomalous rotatory dispersion, since a shallow maximum is observed in the blue region of the spectrum. Galactonic acid gives $[\alpha]_{5461} = -9\cdot78°[M]_{5461} = -19\cdot18°$ as compared with $[M]_{5461} + 7\cdot5°$ for the anhydrous sodium salt and $[M] = 167\cdot6°$ for the lactone. Its rotatory dispersion is normal but complex, since it does not conform to the law of simple rotatory dispersion. Equilibrium between the acid and lactone can be reached from either side; the equilibrium proportions (assuming no δ-lactone to be formed) are acid 25·2 %, lactone 74·8 %. T. M. L.

3415. Photoelectric Polarimetry. Part I. L. Ebert and G. Kortüm. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 105–133, *June*, 1931.—The authors describe in detail the structure and method of working of a photoelectric polarimeter based on the substitution principle. The apparatus may be employed for accurate rotation and absorption measurements up to 254 $\mu\mu$, and especially for the determination of small differences. [See also Abstract 3976 (1930).] H. H. Ho.

3416. Magneto-Optical Dispersion of Organic Liquids. Part III. Active Isoamyl Alcohol and Normal Propyl Formate. E. Thomas and E. J. Evans. *Phil. Mag.* 11. *pp.* 1220–1232, *June,* 1931.—The work now recorded is a continuation of a previous investigation [see Abstract 2231 (1931)]. For various wave-lengths in the visible and ultra-violet regions of the spectrum, the magneto-optical dispersion of isoamyl alcohol and normal propyl formate can be represented by the equations $n\delta = 5\cdot82_8 \times 10^{-3}\lambda^2/[\lambda^2 - (0\cdot1165)^2]^2$ and $n\delta = 4\cdot910 \times 10^{-3}\lambda^2/[\lambda^2 - (0\cdot1077)^2]^2$ respectively, where n is the refractive index, and δ Verdet's constant in minutes per cm. gauss for wave-length λ. The natural dispersion of isoamyl alcohol and normal propyl formate is represented by $n^2 = 1\cdot9574_9 + 0\cdot968_7 \times 10^{-10}/[\lambda^2 - (1\cdot165 \times 10^{-5})^2]$ and $n^2 = 1\cdot8690_8 + 0\cdot896_8 \times 10^{-10}/[\lambda^2 - (1\cdot077 \times 10^{-5})^2]$ respectively. The values of e/m for isoamyl alcohol and normal propyl formate calculated from the magneto-optical and natural dispersion measurements are $1\cdot05 \times 10^7$ and $0\cdot96 \times 10^7$ e.m.u. respectively. H. H. Ho.

3417. Electro-Optical Kerr Effect in Gases. E. C. Stevenson and J. W. Beams. *Phys. Rev.* 38. *pp.* 133–140, *July* 1, 1931.—The electric double refraction or Kerr electro-optical effect in CO_2 has been investigated as a function of the density and of the temperature. A method of study has been developed by means of which it is possible to work at several hundred atmospheres pressure and with high electric field strengths. The polarising prisms and the Kerr cell are enclosed in the same pressure chamber, thus eliminating errors due to strains in the windows. The double refraction of the emergent light is measured by means of a photoelectric cell arrangement. The Kerr constant in CO_2 was found to vary with density over the range 0·08 to 0·18 gm./cm.^{2} by about the amount to be expected from theory. The temperature variation, also, was in approximate accord with theory. Preliminary results show an easily measurable effect in oxygen and nitrogen, the former being larger. AUTHORS.

3418. Diffraction of a Plane Wave at a Slit of Finite Width. M. J. O. Strutt. *Zeits. f. Physik,* 69. 9–10. *pp.* 597–617, *June* 8, 1931.—The problem of diffraction of a plane electromagnetic or sound wave at a slit of finite width bounded by an infinite plane screen, previously solved by Schwarzschild principally for wide slits at normal incidence, is now solved rigorously with the help of Mathieu functions. The solution includes the case of oblique incidence, and passes over, at small slit-widths, into Rayleigh's approximation formulæ. By means of the example of a sound wave, it is shown numerically that Kirchhoff's approximation for very wide slits agrees more closely with experiment for a slit only ½-wave-length wide than does Rayleigh's approximation for narrow slits. For a slit-width greater than one wave-length the classical theories of Young, Fresnel and Kirchhoff agree closely with the exact calculation. The paper contains a comprehensive Bibliography. C. B. A.

3419. Periodic Light Scattering. J. Plotnikow and S. Nishigishi. *Phys. Zeits.* 32. *pp.* 434–444, *June* 1, 1931.—Longitudinal scattering in water and aqueous solutions is studied by sending light from a carbon arc through a cubic tank of 10 cm. side, and photographing the light every minute, giving 2 sec. exposure. The diameter in mm. of the circle at which the blackening is the same as that of a weakly-blackened standard plate is then taken as a measure of the scattering. It is found that the scattering is periodic for water, alcohol-water mixtures and other aqueous solutions. The effect is attributed to the periodic formation and breaking up of complexes of water molecules, formed by association between molecules owing to the presence of the unsatisfied 4 valencies of the O atom. The amplitudes and frequencies are found to be dependent upon temperature and concentration. Pure water is particularly investigated; the higher the temperature the smaller are the amplitudes. Between 44° and 28° fairly sharp rings sometimes appear. The substances investigated were water, aqueous solutions of ethyl-, methyl- and propyl-alcohols, acetone, glycerin, formaldehyde, H_2O_2, sugar and of some acids and salts. Analogy is drawn between this rhythmic phenomena in water complexes and other rhythmic phenomena in biological processes. A. C. M.

3420. Double Scattering of Light Quanta. J. Blaton. *Zeits. f. Physik*, 69. 11–12. *pp.* 835–849, *June* 13, 1931.—First and second approximations are obtained to solutions of the differential equation of the wave function of a perturbed atom when a plane-polarised beam of light of frequency ν falls upon it. It is shown that the charge and current densities of the atomic system vary with frequency 2ν as well as ν. Coherent scattered radiation of this frequency 2ν is not present for two reasons: (1) the very dipole and quadrupole moments which would contribute to it vanish in the quadratic effects considered; and (2) the light of frequency 2ν radiated by those moments which do not vanish is extinguished by interference, except for that caused by inhomogeneity of the medium. The splitting up of the eigenvalues by a plane-polarised beam of light is shown to arise out of a quadratic Stark effect due to the electric field in the light beam. An expression for the electromagnetic field at a great distance from a sheet of quadrupoles of frequency ν is calculated. N. D.

3421. Shadow Fringes Due to Non-Axial Aberration. F. Scandone. *N. Cimento*, 8. *pp.* 157–167, *April*, 1931.—A further study of the elliptical and hyperbolic fringes observed by Ronchi [see Abstract 100 (1931)] and a special investigation of astigmatism and coma. E. E. F. d'A.

3422. Interference in Thin Metallic Films. H. W. Edwards. *Phys. Rev.* 38. *pp.* 166–173, *July* 1, 1931.—The phenomenon of the coloured appearance of thin metallic films sputtered upon glass or upon other metals, when viewed in white light, is explained as being caused by interference. Some qualitative observations of cyclic changes of colour are given which support this viewpoint. Mathematical expressions are derived from Maxwell's electromagnetic equations to express the change of phase as the wave train is reflected from a metal surface in air, from metal in metal, for refraction as the wave enters the metal from air and from air into metal. Use of the values of the indices of refraction and absorption for massive metals indicates fair substantiation of experimental results. Fritze's values of the optical constants for thin metals do not seem to give agreement between theory and experiment. The thickness of the film of copper necessary to produce a yellow colour (interference for $\lambda = 0{\cdot}48\mu$) when calculated from the index of refraction $(1{\cdot}13)$ is found

to be 3·5 times larger than the value found by weighing the total deposit. The balance of evidence seems to support the theory of interference.
AUTHOR.

3423. Half-Silvering Interferometer Plates. R. Ritschl. *Zeits. f. Physik*, 69. 9–10. *pp.* 578–585, *June* 8, 1931. *From the Reichsanstalt.*—Apparatus is described in which two interferometer mirrors can be silvered simultaneously to the same degree. The thickness of the deposit can be measured by determination of the transparency during the deposition, so that the process is controllable. The optical and mechanical quality can be improved subsequently, the reflecting power by acid vapours and the firmness by the action of oxygen. The acid vapours increase and the oxygen lowers the electrical conductivity of the layer. The two glass plates are placed opposite one another about 25 cm. apart, and the source of silver vapour is placed half-way between. This consists of a **V**-shaped heater of tungsten wire, with a drop of molten silver adhering to the bottom of the **V**, the adhesion being helped by a little platinum. The whole is enclosed in a gas-tight vessel of tinned brass evacuated by a large-capacity steel mercury-vapour pump. A. C. M.

3424. Multiple Images in Car Windows. H. M. Reese. *J.O.S.A.* 21. *pp.* 282–285, *May*, 1931.—Looking obliquely through a plate-glass window, *e.g.*, a motor-car wind-screen, multiple images are seen, about equally spaced in angle, and diminishing in intensity. It is shown that these usually are due, not to multiple reflections in the glass bringing about a lateral shift, but to the glass being usually slightly prismatic. A. C. M.

3425. New Vacuum Double Monochromator for the Region from 0·160 μ to 0·130 μ in the Infra-Red. C. Leiss. *Zeits. f. Physik*, 68. 7–8. *pp.* 559–565, *April* 7, 1931.—A description is given of a double monochromator which can be evacuated and arranged for use in the optics of quartz and fluorspar. With its help it is possible to extend investigations into the region described by Schumann, who first showed that rays of shorter wave-length are absorbed strongly in air. The substitution of the more transparent fluorspar for quartz permits of extension of the observations. Handke has shown that quartz in evacuated apparatus is still transparent down to 0·160 μ, so that even with quartz more far-reaching observation can be made with evacuated vessels than with those in which there is air. J. J. S.

3426. Quartz Double Monochromators. C. Leiss. *Zeits. f. Physik*, 69. 9–10. *pp.* 678–685, *June* 8, 1931.—The adjustments of the prisms and lenses of the two parts of the double monochromator are carried out by a mechanism which is actuated by turning a drum on which are marked the wave-lengths of the light which will pass through the instrument for each adjustment of the same. H. N. A.

3427. Microphotometric Measurements by Means of a Projector. E. G. Jones and H. L. Brose. *Journ. Sci. Instruments*, 8. *pp.* 145–152, *May*, 1931.—A new method of microphotometry is described which involves the use of an N.P.L. projector and photoelectric cells. A bridge arrangement of the cells is adapted to secure a more effective working of the electrometer. As an example of the possible applications of this method, darkenings, such as spectral lines produced on a photographic plate, have been investigated, and the absorption of a 0·1 *N* solution of silver nitrate in the ultra-violet region has been measured and found to agree satisfactorily with results obtained previously by other workers. AUTHORS.

3428. Sensitometry of Papers for Subjects of Narrow Contrast Range, Especially for Aerial Photography. M. Lebelle. *Soc. Franç. Phot. et Ciné., Bull.* 18. *pp.* 26–38, *Feb.*, 1931.—An attempt is made to reduce to two the number of sensitometric magnitudes for characterising a photographic paper for reproducing aerial photographs, the one related to the difference of the abscissæ of the points limiting the utilisable region of the characteristic curve, and the other to the contrast. Since, in aerial photography the negative emulsion is mostly in the region of under-exposure, the conditions required of a paper to give satisfactory detail are considered in the two cases: (1) for a subject in the under-exposure region at the limit of utilisation, and (2) for a subject in the medium-exposure region of the characteristic curve of the negative. T. H. P.

3429. Unit of Photographic Intensity and the Present Status of its International Standardisation. L. A. Jones. *J.O.S.A.* 21. *pp.* 361–368, *June*, 1931.—The various recommendations made by different committees with regard to the standardisation of the unit of photographic intensity are detailed, including the resolution in this direction passed by the executive council of the Optical Society of America in February, 1929. T. H. P.

3430. Efficiency of Safe Lights for Dark-Room Use. L. V. Chilton. *Phot. J.* 71. *pp.* 226–233; *Disc.*, 233–234, *June*, 1931.—The ratio of visual intensity to actinic intensity, in arbitrary units, of any light source is defined as its " dark-room value "; considering a combination of light source *plus* filter, the ratio of its dark-room value (screened) to its dark-room value (unscreened) gives the efficiency of the filter. A description is given of two methods of determining filter efficiencies with reference to a given primary source and a given photosensitive material, (*a*) by direct measurements of visual and actinic intensities; (*b*) by a study of the spectral sensitivities of the material and of the eye, in conjunction with the spectral absorption of the filter. The most efficient filter for use with any combination of light source and sensitive material is monochromatic, the wave-length of optimum transmission depending only on the spectral sensitivity of the eye and of the material, and not on the primary light-source employed. Consideration of the imperfections of available filters and of efficiency of power consumption leads to the recommendation of high-temperature sources. L. V. C.

3431. Ultra-Rapid Kinematograph Camera Giving 2000 to 3000 Exposures per Second. E. Huguenard and A. Magnan. *Comptes Rendus*, 192. *pp.* 1370–1372, *June* 1, 1931.—By use of four objectives, each focussing on one quarter of the width of a normal film, and a sector-shutter arranged to open them in uniform succession 3 times per sec., twelve photographs are obtained in the length of film usually occupied by one. When film is reeled off at 3 m. per sec., this gives 2400 images per sec. With film speeds already attainable, 10,000 photographs per sec. are possible. The method has been applied to a study of the free flight of insects. C. B. A.

3432. Theory of Resonance Fluorescence. V. Weisskopf. *Ann. d. Physik*, 9. 1. *pp.* 23–66, *April* 17, 1931.—The Dirac theory of the interaction between light and matter does not give information concerning such matters as are concerned with the breadth of resonance lines, although general information concerning intensity and polarisation is obtained. In this paper the natural breadth of absorption lines is calculated, and is found to be somewhat broader than that of the emission line. The transition from resonance-fluorescence to Rayleigh scattering is investigated. The Heisenberg rules for polarisation follow from the calculation. In the presence of a weak magnetic field, depolarisation and rotation of the plane of polarisation come in. The rotation of the plane of polarisation is proportional to Δ/γ, where Δ is the Larmor frequency and γ is the transition probability from the excited to the normal state. The rotation of the plane of polarisation in weak magnetic fields is less the further the exciting frequency is from the resonance frequency, and disappears when the difference between these frequencies is large compared with the line-width (*e.g.*, Rayleigh scattering). The resonance radiation has a fixed phase relationship to the exciting radiation. If the separation of atoms is of the same order as the wave-length of the resonance radiation there will be a coupling between them. This coupling is discussed. A. C. M.

3433. Fluorescence and Absorption Spectra of Phosphorus Vapour. A. Jakowlewa. *Zeits. f. Physik*, 69. 7–8. *pp.* 548–564, *May* 28, 1931.—The fluorescent and absorption spectra of superheated phosphorus vapour belonging to the P_2 molecule is described and analysed. The heat of dissociation of the molecule is calculated, and comes to about 120 k. cal./mol. (5·2 volts). The convergency frequency of the excited P_2 molecule corresponds to the breakdown of the state $P(^2D) + P(^2D)$. J. E.

3434. Fluorescent Spectrum of Protochlorophyll. C. Dhéré. *Comptes Rendus*, 192. *pp.* 1496–1499, *June* 8, 1931.—Protochlorophyll is the biological antecedent of chlorophyll. Photograms of the spectra of protochlorophyll in methyl alcohol and in ethyl ether show that these are identical except that the single band is narrower in the ether and opens out more definitely in the violet. Treatment of solutions of protochlorophyll obtained from etiolated corn, with various amounts of light (from complete darkness) and the corresponding spectrograms show, without doubt, that chlorophyll is the light product of protochlorophyll. J. E.

3435. Effective Collision Radius of Sodium Atoms with Iodine Molecules and Atoms. A. Terenin and N. Prileshajewa. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 72–92, *June*, 1931.—In the dissociation of NaI, excited Na atoms of various speeds are produced. The D-line emitted from them is extinguished by added iodine vapour. Photometric measurements of the intensity of the D-line against the pressure and temperature of the iodine vapour gives the effective cross-section of the excited Na atoms as regards collision with iodine molecules or atoms. In the first place, a notable decrease of the cross-section with increase of the velocity of the Na atoms was found, and the collision with iodine atoms gives a collision radius some ten times smaller than the maximum obtained with iodine molecules showing not nearly so much dependence on the speed. [See also Abstract 2514 (1930).] J. E.

3436. Extinction Distribution of Alkali Phosphors and the Quantum Output of a KCl Phosphor Activated with Tl. W. Bünger and W. Flechsig. *Zeits. f. Physik*, 69. 9–10. *pp.* 637–653, *June* 8, 1931.—A photometric study was made of various thallium-containing phosphors. The simplest results were obtained with KCl. The same light sum is

obtained with a normally decaying phosphor and with one whose decay is speeded up by excitation with an " extinguishing " radiation, indicating that extinction is simply the same process as emission. A determination of the absolute output for ultra-violet excitation and emission gives the quantum equivalent of the output as 1, but for longer wave-lengths the output is appreciably less. The perfect efficiency of the emission at 355 mμ contradicts Lenard's idea of local temperature-rises. A mechanism of the emission and absorption processes is suggested, based on electron exchanges between regions in the grating whose structure is not specified.
J. E.

3437. Band Spectra. E. Rabinowitsch. *Zeits. f. Elektrochem.* 37. *pp.* 91–108, *Feb.*, 1931.—A general article dealing with band spectra. After an introduction in which the various terms used are explained, the oscillation spectrum is considered in detail. Among subjects connected with the oscillation term system, isotopy, dissociation energy, potential curves and predissociation are dealt with for diatomic molecules. Extension to polyatomic molecules is indicated. Further sections are promised.
F. S.

3438. Relative Intensities of Balmer and Paschen Lines. U. Doi. *Tokyo B.D., Sci. Reports,* 1. 7–12. *pp.* 97–103, *May* 23, 1931. *In English.*—Ornstein and Burger's measurements on the relative intensities of the Balmer and Paschen lines show marked discrepancies from the values calculated by the hitherto accepted expression of transition probability. Agreement is, however, obtained by adopting the author's expression [see Abstract 1467 (1931)]. F. S.

3439. Excitation of Secondary and Balmer Spectrum of Hydrogen by Electronic Impact in Molecular Hydrogen and by Protons of High Velocity. L. S. Ornstein, A. A. Kruithof and W. A. M. Dekkers. *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 610–614, 1931.—As a result of the observations made with electrons accelerated with different voltages between 18 and 50, excitation curves were drawn showing the intensities of various lines in the triplet and singlet lines, and of the Balmer lines, as a function of the voltage. The curves have been reduced to give the same value for all three classes of line at 23 volts. For all three curves there is, at first, a strong drop in intensity with rising voltage, and the curves coincide with one another. Above 23 volts they differ greatly from one another. The singlet and triplet lines have the same forms of curve as was found for the helium singlet and triplet lines. The excitation of the triplets diminishes more rapidly than that of the singlets, and the results confirm Richardson's classification. The ratio between the intensities of the Balmer lines and of the singlet bands at corresponding velocities, plotted against the voltage, gives between 24 and 50 volts a straight line which can be represented by $I_B/I_S = AV$. If the same is done with triplet lines a strongly curved line is obtained. The ratio of the intensity for Balmer lines in molecular hydrogen I_B to that in atomic hydrogen I_{Ba} can be represented by $I_B/I_{Ba} = BV$. It seems, therefore, that the excitation function of atomic hydrogen, and that for singlet-singlet transitions in molecular hydrogen, is about the same in the voltage region under consideration. Some suggestions are made as to the nature of the processes involved; it seems probable that collisions of protons produced by electronic impacts are of importance in the phenomena.
H. N. A.

3440. Spectrum of H_2 and Bands Ending on $2p^3\Pi$ Levels. O. W. Richardson and P. M. Davidson. *Roy. Soc., Proc.* 131. *pp.* 658–683, *June* 3, 1931.—It is assumed that in all the electronic states of H_2 with which these bands are concerned only one electron gets excited, the other being in an *s* state ($l = 0$); the resultant azimuthal quantum number L of the two electrons is equal to the azimuthal quantum number l of the excited electron. In the tables showing the different band lines the first column gives the designation of the line as R′1, R2, R′3, R4, Q1, Q′2, Q3, Q′4, P′1, P2, P′3, P4, in the case of the 0 → 0 band of $3d^3\Sigma \rightarrow 2p^3\Pi_{ab}$; here dashed letters indicate transitions between weak levels, and undashed between strong levels. The succeeding columns give the wave number; the intensity of the lines as measured by Kapuscinsky and Eymers; the eye estimates of Gale, Monk and Lee; the response to high pressure, low pressure, added helium or the condensed discharge; the effect of a magnetic field; the intensities at room-temperature and at that of liquid air; and the excitation potential of the final level of the lines. There are eight of these tables. Others give details of the final rotational terms of $d^3 0 \rightarrow 0$ and $d^3 1 \rightarrow 1$ bands; the rotational constants of $np^3\Pi$ levels; 1 → 0 vibrational intervals of $n^3\Pi_{ab}$ levels; 1 → 0 vibrational intervals of $3d^3\Sigma$, $3d^3\Pi_{ab}$, $3d^3\Delta_{ab}$; initial and final rotational terms of the $nd^3\Sigma\Pi\Delta \rightarrow 2p^3\Pi$ complex; and energy of electronic levels. H. N. A.

3441. Distribution of Energy in the Continuous Spectrum of Molecular Hydrogen. D. Chalonge. *Comptes Rendus*, 192. *pp.* 1551–1553, *June* 15, 1931.—Variations in the distribution of energy in the continuous spectrum of hydrogen, as the pressure of the gas is progressively reduced from 35 mm. of mercury to high vacuum, are described and interpreted in terms of a modified form of the theory proposed by Winans and Stueckelberg to explain the spectrum [see Abstracts 1549 (1929) and 4011 (1930)]. J. S. G. T.

3442. Application of Merton's Method of Measuring the Half-Width of a Spectral Source to the Fabry and Perot Étalon. J. K. Robertson. *Canad. J. of Research*, 4. *pp.* 305–311, *April*, 1931.—A discussion is given concerning the possibility of applying to a Fabry and Perot étalon, Merton's method of evaluating the half-width of a spectral source. Using sources of known half-width as determined from Doppler effect and kinetic theory considerations, the writer has plotted the exact distribution of intensity in the image obtained with an étalon of about 1 cm. thickness. By means of the resulting graphs a comparison is made between results obtained with the use of rigid theory and with a simplification similar to that previously used by Merton for another instrument. It is shown that the simplified method cannot in general be applied to an étalon. AUTHOR.

3443. Standard Wave-Lengths of Aluminium in the Extreme Ultra-Violet. J. Söderqvist and B. Edlén. *Zeits. f. Physik*, 69. 5–6. *pp.* 356–360, *May* 12, 1931.—Using the vacuum grating spectrograph previously described [see Abstract 2192 (1930)] and a condensed vacuum spark, about 50 lines belonging to AlIV and higher degrees of ionisation have been photographed between 312 and 68 Å. Their wave-lengths have been determined by the coincidence method in higher orders, and eleven of the most intense lines have been directly compared with the iron spectrum. An accuracy of 0·003 to 0·01 Å. is claimed. F. S.

3444. Technique of Spectral-Intensity Measurement. C. W. W. Read and L. W. Johnson. *Phil. Mag.* 11. *pp.* 1152–1169, *June*, 1931.—The effect on spectroscopic intensity measurements, obtained by the use of photographic plates, of such factors as time of exposure, wave-lengths of light, kind and age of plate, and conditions of development are considered. Experiments are described in which plates of various types are calibrated, and it is concluded that a characteristic curve must be obtained for each plate and for each wave-length. Also, if the plate be judiciously chosen and a large number of readings made, an accuracy of about 5 % in relative intensity measurement may be expected. F. S.

3445. Difference in the Self-Reversal of Ne Lines Excited by Direct and Alternate Currents. Part II. H. Nagaoka and T. Mishima. *Imp. Acad. Tokyo, Proc.* 7. *pp.* 192–194, *May*, 1931. *In English.*—In continuation of the investigations described in Part I [see Abstract 3100 (1931)] it is further found that the difference between the reversal of the Ne lines when excited by a.c. and d.c. depends largely on current density. The self-reversal of lines of the (s_2, p) group differs distinctly from that of lines of the (s_3, s_4, s_5; p) groups; the lines of the latter groups exhibit less distinct differences in behaviour. The reversal phenomenon is complex and is dependent on the tube construction, the gas pressure, and the gas temperature. J. E. K.

3446. Hyperfine Structure of Spectral Lines of Silver Arc in the Visible and the Ultra-Violet Regions. W. Mohammad and P. N. Sharma. *Indian Journ. Phys.* 6. *pp.* 75–80, *June* 15, 1931.—Lines of the silver arc spectrum are excited in a vacuum arc lamp and photographed in the visible and ultra-violet regions, high resolving power being obtained by quartz-lummer plates. Only two lines were found to possess hyperfine structures; $\lambda = 3383\cdot02$ ($2p_2 - 1s$) and $\lambda = 3280\cdot80$ ($2p_1 - 1s$) each of which consists of three components. It follows that the $1s$ term is a triplet level with separations of $0\cdot218$ and $0\cdot166$ cm.$^{-1}$. J. E. K.

3447. Displacements in the Spectrum of Singly-Ionised Oxygen. K. Asagoe. *Tokyo B.D., Sci. Reports*, 1. 7–12. *pp.* 105–125, *May* 23, 1931. *In English.*—In continuation of previous work [see Abstract 1545 (1931)] with the same apparatus, the shifts of various lines in the oxygen spectrum have been observed at various pressures up to atmospheric. It is found that terms for which $n = 3$ are relatively steady, while the amount of shift increases with increase in n. A number of unclassified lines were also examined. F. S.

3448. Visible Halogen Bands, with Special Reference to ICl. R. S. Mulliken. *Phys. Rev.* 37. *pp.* 1412–1415, *June* 1, 1931.—It is pointed out that the dissociation of excited ICl molecules, after absorption of light in the visible bands, into normal atoms is in harmony with theory. In analogy with the other halogens, these bands probably belong to a ${}^3\Pi \leftarrow {}^1\Sigma^+$ transition. The upper level of the bands is, however, doubtless not just the 0^+ part of the ${}^3\Pi_0$ as in the homonuclear halogen molecules, but is probably the whole ${}^3\Pi_0$, or else the ${}^3\Pi_1$. Detailed arguments against the possibility that the upper state of the halogen bands may be ${}^3\Sigma$ are given. Conclusions drawn in previous papers [see Abstracts 140 and 1096 (1931)] from the behaviour of the I_2 bands in magnetic fields are revised. AUTHOR.

3449. Ultra-Violet Absorption Spectrum of Sulphur Dioxide W. W. Watson and A. E. Parker. *Phys. Rev.* 37. *pp.* 1484–1492, *June* 1, 1931.—Measurements of spectrograms of the ultra-violet SO_2 absorption bands taken at different pressures, tube lengths and temperatures, together with known infra-red and Raman frequencies serve to locate the three fundamental vibrational series. Tables giving the band assignments to these sequences are included. The three lower state frequencies for infinitesimal amplitude are 1369, 1164 and 610 $cm.^{-1}$, while for the excited state the corresponding frequencies are 341, 387 and 290 $cm.^{-1}$. The types of addition series are discussed. The excited state $\Delta\nu_v : v$ curves for $v<4$ have a positive slope, while for $v>4$ there is a sudden reversal to the usual negative anharmonic coefficient. The three ground state frequencies indicate a value of 34° for the half-angle at the apex of the SO_2 triangular model. Comparisons of the heats of dissociation estimated from the extended areas under the $\Delta\nu_v : v$ curves with thermal and spectroscopic data suggest the process $SO_2 \rightarrow S + O_2$ for the two symmetrical vibrations and $SO_2 \rightarrow SO + O$ for the asymmetrical vibration. The dissociation products appear to be the same in the two electronic states. AUTHORS.

3450. Continuous Absorption Spectra in the Ultra-Violet. H. D. Schmidt-Ott. *Zeits. f. Physik*, 69. 11–12. *pp.* 724–734, *June* 13, 1931.—According to the theory of Franck and Condon, continuous absorption is to be expected in the case of molecules which undergo photochemical dissociation. This has been investigated in the case of CsI, RbI, NaI, CsBr and CsCl. The salts were heated in a special form of quartz tube, which had been well out-gassed, to a temperature of 690°. A continuous hydrogen spectrum was used to obtain the absorption of the vapours and the results are in agreement with the dissociation theory. F. S.

3451. Absorption Spectra of Complex Salts. R. Samuel. *Zeits. f. Physik*, 70. 1–2. *pp.* 43–73, *June* 20, 1931.—The continuous hydrogen spectrum in the ultra-violet is used as source for measurements on the absorption of solutions of complex salts. The substances investigated were 21 different complex salts involving the metals Fe, Co, Ni, Pd and Pt, and the object was to study coordinative binding. A. C. M.

3452. Absorption of Infra-Red Radiation by Water Vapour. E. K. Plyler and W. W. Sleator. *Phys. Rev.* 37. *pp.* 1493–1507, *June* 1, 1931.—Making use of a spectrometer with a salt prism and echelette gratings, and a Moll thermal relay, the authors have re-examined [see also Abstract 2701 (1925)] with increased resolution the four absorption bands of water vapour whose centres lie near 1·87 μ, 2·66 μ, 3·15 μ and 6·26 μ. The new study has greatly increased the number of measured lines. Near 6·26 μ and 3·17 μ the number has been more than doubled. The new lines are mostly weak ones, but the work has resulted in a better determination of the wave-lengths of many strong lines, which now appear as sharp single effects freed from the former confusion in which several lines were taken for one. The centre of the harmonic of the band at 6·26 μ is seen to be better placed at 3·168 μ than it was formerly at 3·11 μ. It also appears that this band has no absorption at the centre, and is of the same type as the fundamental. AUTHORS.

3453. Repulsive Energy Levels in Band Spectra. J. Kaplan. *Phys. Rev.* 37. *pp.* 1406–1411, *June* 1, 1931.—An explanation is given for many cases of anomalous intensity distribution in the band spectra of diatomic molecules. Use is made of an interaction between the known energy levels of molecules and energy levels which are produced by the repulsive interaction of pairs of atoms in their normal and metastable energy levels. The chief types of anomalies which are discussed are those corresponding to the sudden cutting off of a group of bands at some low value of v', the initial vibrational quantum number, and the failure of bands to agree with the Franck-Condon theory. Use is made of these ideas to explain the long life of active nitrogen. AUTHOR.

3454. Band Spectrum of Boron Hydride. W. Lochte-Holtgreven and E. S. van der Vleugel. *Zeits. f. Physik*, 70. 3–4. *pp.* 188–203, *June* 27, 1931.—In this investigation two bands of BH at 4332·7 and 4367·1 Å. have been photographed and analysed under high dispersion. It appears that the bands proceed from a ${}^1\Pi \rightarrow {}^1\Sigma$-transition. In both states the molecule is strongly deformed by increasing rotation. Weaker companions are found at the intensive band lines which are ascribed to the isotopic molecule $B^{10}H$. A wider band at 3694·3 Å. has been analysed and ascribed to a ${}^3\Pi \rightarrow {}^3\Sigma$-transition. The two transits are distinguished only by the different electronic spins. A description is also appended of boron chloride (BCl) bands. H. H. Ho.

3455. Structure of Helium Arc Line 3888. R. C. Gibbs and P. G. Kruger. *Phys. Rev.* 37. *pp.* 1559–1560; *Disc.*, 1561, *June* 15, 1931.—The helium arc line ($1s2s\,{}^3S_1 - 1s3p\,{}^3P^\circ_{0,1,2}$)3888 Å., has been examined for structure and has been resolved into the three components which are predicted by theory. The $1s3p\,{}^3P^\circ_{0,1,2}$ levels are inverted, which is in agreement with previous results for the $1s2p\,{}^3P^\circ_{0,1,2}$ levels. The frequency differences in the present case are: $\nu_{0,1} = 0\cdot192$ cm.$^{-1}$, $\nu_{1,2} = 0\cdot165$ cm.$^{-1}$. AUTHORS.

3456. Luminous Vapours from a Mercury Arc. M. Ram and K. C. Nanda. *Indian Journ. Phys.* 6. *pp.* 15–27, *June* 15, 1931.—Experiments on the luminosity of the mercury vapour distilled from a mercury arc point to the fact that positively charged mercury atoms are responsible for the phenomena. The life of afterglow has been determined and found to be 0·03 sec., indicating the probability of the entities in the afterglow being metastable mercury atoms. The question of the most probable value of the energy content of the atoms in the afterglow is discussed from spectroscopic data and the value thus obtained is 14·8 volts. Observations made on the decay of the intensity of the afterglow are found to be consistent with the hypothesis put forward here. AUTHORS.

3457. Under-Water Spark Spectra in the Infra-Red. (Miss) B. Setna. *Indian Journ. Phys.* 6. *pp.* 29–34, *June* 15, 1931.—The spectra of condensed discharge under water between Cu, Zn, Cd, Fe, W and Mo electrodes have been studied in the visible and infra-red region up to 0·85 μ. Only the principal series lines are found to be present in absorption, as found by previous workers, and the experiments fail to detect any subordinate series lines in absorption. A number of strong bands due to water have also been recorded in the infra-red. AUTHOR.

3458. Third Spark Spectrum of Krypton. D. P. Acharya. *Indian Journ. Phys.* 6. *pp.* 35–39, *June* 15, 1931.—In a previous paper on the second spark spectrum of Kr, a long list of new lines of Kr in the extreme ultra-violet was published by the present author [see Abstract 840 (1931)]. In this paper some of these lines have been classified and are believed to be due to the different transitions of Kr^{+++}. Only quartets, however, have been discovered, and it is felt that more accurate measurement of lines in this region, preferably with a vacuum spectrograph, is necessary to identify doublets and inter-combination between quartets and doublets. AUTHOR.

3459. Spectrum of Doubly-Ionised Carbon, CIII. I. S. Bowen. *Phys. Rev.* 38. *pp.* 128–132, *July* 1, 1931.—With new experimental data 54 lines of CIII have been classified. A large number of these lines involve terms in which both valence electrons are excited. The ionisation potential deduced from this classification is 47·7 volts. The classification of a few additional CII lines is also given. These analyses fix the relative position of the singlets and triplets in CIII and the doublets and quartets in CII. AUTHOR.

3460. New Absorption Bands of Ammonia, Methyl Bromide, Methyl Iodide and Carbon Dioxide in the Infra-Red Spectrum. W. W. Sleator. *Phys. Rev.* 38. *pp.* 147–151, *July* 1, 1931.—The recording spectrometer has shown near the wave-length 16·1 μ an absorption band of ammonia not hitherto observed in detail, and bands due to methyl bromide and methyl iodide, near wave-lengths 16·4 μ and 18·8 μ respectively. It has also shown the strong absorption band due to carbon dioxide near 15 μ to be more complex and extensive than has previously been indicated. AUTHOR.

3461. Wave-Length Standards in the Spectra of Carbon and Tin in the Schumann Region. R. V. Zumstein and D. S. Marston. *Phys. Rev.* 38. *pp.* 305–308, *July* 15, 1931.—In the region 2000 to 1500 Å. the strong lines of CI and SnII have been measured to about 0·02 Å. by direct comparison with iron. The dispersion of the second order lines was 3 Å. per mm., and the carbon groups were well resolved. The 1930·93 line of carbon for the arc has a value as given by Selwyn which differs from the value found for the spark. For the carbon groups at 1656 and 1560 values are obtained very close to the accepted ones. The tin wave-lengths are 1899·875, 1831·75, 1811·206, 1757·91, 1699·39. For the last two the error is about 0·03 Å. AUTHORS.

3462. Effect of Temperature upon the Ultra-Violet Band Spectrum of Ozone and the Structure of this Spectrum. O. R. Wulf and E. H. Melvin. *Phys. Rev.* 38. *pp.* 330–337, *July* 15, 1931.—The ultra-violet absorption of ozone in the region 3400–2300 Å. consists of a large number of bands appearing against a background of continuous absorption. The effect of temperature upon this spectrum has been studied over the range − 78° to 250° C. A definite though small effect has been observed. Grossly it manifests itself as an increase in contrast with decreasing temperature. Photometric results show this to be a decrease in absorption between the bands, all of the bands appearing to come from normal vibrational levels of very low if not the lowest energy. Though somewhat diffuse, the bands tend to degrade to the red. The observed influence of temperature can be explained as a decrease of intensity in the continuous background, and also in the higher rotational absorption of the bands, with decreasing temperature. Discontinuities in the intensity relations and the regular spacing of certain of the bands have led to a partial vibrational analysis indicating two active vibrational degrees of freedom in the excited electronic state. The observed change in the absorption with temperature may affect somewhat the estimates which have been made of the amount of ozone existing in the upper atmosphere, and may possibly afford a method of estimating the temperature of the upper atmosphere. AUTHORS.

3463. Stereophotographic Models of Electron Motion in Stark Effect. R. W. Wood. *Phys. Rev.* 38. *pp.* 346–350, *July* 15, 1931.—By means of multiple exposures with a stereoscopic camera of a rotating wire frame representing the curved quadrangle formed by the intersection of the parabolic coordinates of the Epstein-Schwarzschild treatment of the Stark effect, within which quadrangle the electron is progressively advanced along a properly curved wire, the orbital motion within the anchor-ring is very clearly brought out. The pictures when viewed with a stereoscope show the anchor-ring as a wire cage within which the precessing orbit appears as a white dotted line. The change in orientation and eccentricity of the orbit, with the constancy of the distance of the electric centre from the YZ plane (field parallel to X), is easily seen. Photographs are shown illustrating various assignments of the quantum numbers n_1 and n_2.
AUTHOR.

3464. Photometric Study of the Appearance of Spectral Lines in a Condensed Spark. H. V. Knorr. *Phys. Rev.* 37. *pp.* 1611–1621, *June* 15, 1931.—The time interval between the time of appearance in a condensed spark discharge of the arc lines 4678 Å., 4722 Å., 4811 Å., $(2^3P_{012} - S^3S_1)$ of zinc, 4680 Å., 4800 Å., 5086 Å. $(2^3P_{012} - 2^3S_1)$ of cadmium, the air lines 4347 Å., 4631 Å. and 5001 Å. was measured visually, using the Kerr cell method developed by Beams. A photographic method was developed whereby it was possible to determine from photometric measurements the variation of the intensity of an individual line with the time after the beginning of the spark. The time of first appearance, or zero intensity, is inferred from the extrapolation of the curves showing the intensity as a function of the time. The arc lines of zinc appear simultaneously. The arc lines of cadmium appear simultaneously but definitely earlier than the zinc arc lines. The air lines appear simultaneously but earlier than the arc lines. The spark lines appear simultaneously but earlier than the arc lines and later than the air lines of the respective elements. The results of the visual and photographic methods do not agree. Neither method gives information that in the case of zinc or cadmium, an electron remains in the 2^3S_1 state for a longer time before dropping to the 2^3P_0 state than before dropping to the 2^3P_1 or the 2^3P_2 state. AUTHOR.

3465. Resolving Power of a Prism Spectrometer for the Infra-Red. J. Strong. *Phys. Rev.* 37. *pp.* 1661–1667, *June* 15, 1931.—The resolving power of a spectrometer in the infra-red is limited by the rate at which energy passes through the exit slit of the spectrometer. Calculation of the energy available for activating a thermocouple, under condition that the exit slit embraces the same frequency range $\Delta\nu$ of spectrum at all times, gives information on the attainable resolving power at various wave-lengths and with various prisms. The best dispersing angle for a sylvine prism to be used from 8 to 22 μ is from 70° to 75°. A lamellar prism construction is described. AUTHOR.

3466. Vacuum Fluorite Spectrograph. G. Cario and H. D. Schmidt-Ott. *Zeits. f. Physik*, 69. 11–12. *pp.* 719–723, *June* 13, 1931.—The fluorite prism and lenses are small, the latter being from 10 to 14 mm. dia. and 100 mm. focal length for D. The construction is such that adjustment can be made by means of the aluminium spark spectrum without evacuation. It is claimed that the resolution is as great as the photographic plate justifies. F. S.

3467. Apparatus for Raman Effect with Large Light-getting Power. H. Hulubei and (Miss) Y. Cauchois. *Comptes Rendus*, 192. *pp.* 935–937, *April* 20, 1931.—A mercury lamp is suspended in a cylindrical parabolic mirror at its focus, with the orifice upwards. The light falls on a conical reflector with generators at 45°, with the tube containing the substance placed vertically along the axis. The scattered light burns out of the top of the tube, and is brought by a right-angled prism on to the slit of the spectrograph. A. C. M.

3468. Monochromatic Excitation of Raman Effect in the Ultra-Violet. H. Hulubei and (Miss) Y. Cauchois. *Comptes Rendus*, 192. *pp.* 1640–1643, *June* 22, 1931.—The Hg line 2536 Å. is used, together with a filter of chlorine under pressure. This method is applied to the apparatus previously described, [see preceding Abstract], and the results are described for water (one line at 3420 cm.$^{-1}$, and lines at 7729, 8243, 8703, 9223, 10,151, 11,264 cm.$^{-1}$, of which 8243 and 10,151 correspond exactly to infra-red bands), and ethyl alcohol (506, 880, 1038, 1436, 2741, 2876, 2929, 2980). A. C. M.

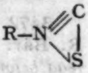
3469. Structure of Raman Bands. A. Kastler. *Comptes Rendus*, 192. *pp.* 1032–1034, *April* 27, 1931.—Certain lines appear as doublets, triplets, etc., in the Raman effect (*e.g.*, water doublet, ammonia triplet). These are shown to be P.R. or P.Q.R. branches of bands. The addition of chlorides to water suppresses one component, and this is interpreted as the suppression of rotation of the molecules (responsible for the difference between the P and R bands) by reason of hydration. Nitrates, however, cause the separation between the bands to increase from 160 cm.$^{-1}$ to 230 cm.$^{-1}$. From the infra-red investigation of water, the PR separation should be 120 cm.$^{-1}$, 140 cm.$^{-1}$, and 220 cm.$^{-1}$ for rotation about the three different directions in the molecule, the longest separation being due to rotation involving the smallest amount of inertia. Consequently it is concluded that with the nitrate solutions, rotation of the water molecules about the axes of the dipole is still possible, so that the Raman lines are separated by a distance corresponding to the 220 cm.$^{-1}$ rather than by a distance corresponding to the mean of the three separations. A. C. M.

3470. Raman Effect. K. W. F. Kohlrausch. *Phys. Zeits.* 32. *pp.* 385–406, *May* 15, 1931.—A review of the subject up to about February, 1931. A. C. M.

3471. Raman Effect and Chemical Problems. A. Dadieu and K. W. F. Kohlrausch. *J.O.S.A*, 21. *pp.* 286–322, *May*, 1931.—A review of the work done to date on the Raman spectra of organic substances, chiefly by the authors. The Raman spectral shifts are tabulated for 127 different substances. The internal vibrations are discussed for the aliphatic C—H and aromatic C—H linkages, and the following linkages, $C{=}C$, $C{\equiv}C$, $C{=}O$, $C{\equiv}N$, NO_2 group, NH_2 group, OH group, benzene nucleus, and the frequency regions, in cm.$^{-1}$, are found to be the following: X–H 2800–3400; X–X, 100–1000; X=X, 1300–1800; X≡X, 1900–2400. The effect of constitutive influences on the internal vibrations is considered. Among the applications to chemical problems considered are (*a*) the detection of tautomerism, (*b*) the constitution of HNO_3, (*c*) the constitution of the CO molecule, (*d*) the nitrite group, (*e*) constitution of the mustard-oils, (*f*) the conjugated double bond, (*g*) constitution of benzene, (*h*) the influence of intramolecular forces. The spatial configurations of molecules of the types $X–CH_3$, $X–CH_2X$, $X_3–CH$, and X_4C are considered, and finally the strength of linkage and work of dissociation. A. C. M.

3472. Polarisation of Raman Lines of CCl_4, Benzene, and SO_3. R. Bär. *Helv. Phys. Acta*, 4. *pp.* 130–135, 1931. *In German. Paper read before the Schweiz. Phys. Gesell., Zürich, May* 2, 1931.—Polarisation of Raman lines observed end-on by Bär's method are compared with the states of polarisation of the same lines observed laterally. Observations are in agreement with the theory, and are similar to those of Menzies [see Abstract 1039 (1930)]. Bhagavantam claims to have observed a line in SO_3 polarised so that the depolarisation is 2, while theory could not expect depolarisations greater than 1. It is pointed out that observations with polarised light allow depolarisations with greater variation in magnitude than when natural light is used. Observing with polarised exciting radiation it is found that the line in question is unpolarised, while if Bhagavantam's observation is correct, a plane polarisation should have been evident. In the case of circular polarisation, observed perpendicularly, one would expect no difference whether circularly polarised or natural light is used. Observed end-on, one would expect lines which are linearly polarised perpendicularly to be still circularly polarised end-on, and this is so. One would expect lines for which the depolarisation is not zero, to show more circular polarisation the less the depolarisation is. Unexpectedly however, lines in CCl_4 having depolarisation 0·8 were oppositely circularly polarised. In benzene, a line having depolarisation 0 and one having depolarisation 0·6 were polarised circularly in the same direction as the incident light. Oppositely polarised are two with depolarisation 1, and also the asymmetric broadening of the Rayleigh lines. A phase difference of π must be introduced in these cases between the two components. It is necessary to assume an asymmetry in the molecule for the depolarisation > 0, and to assume the possibility of excitation in the molecule in two directions at right-angles with a fixed phase difference of π between the two vibrations. Multi-dimensional oscillators are necessary, and these are invoked by Dennison for the vibrations of CH_4, and just these multi-dimensional vibrations in the similar molecule CCl_4 have the property of reversing the direction of circular polarisation. A. C. M.

3473. Raman Spectra of Organic Substances. Cyanogen Compounds. A. Dadieu. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp.* 629–657, 1930.—(1) Describes a small-scale apparatus for the Raman effect in which the liquid is enclosed in a narrow tube (capacity 2½ cc.) placed end-on to the spectrograph. This tube is surrounded by an air space, and then by liquid again, so that the air space acts as a totally reflecting layer, keeping out oblique primary rays, and keeping in oblique scattered rays. (2) A 10 % aqueous solution of chinosol (disinfectant) in 5 mm. thickness is found to be a useful filter for removing 4046 Å.; not only is this useful for helping in the identification of the origin of lines, but also it is found that the removal of this line and the use of 4358 Å. alone prevents troubles through the excitation of continuous spectrum. (3) An electric heating device is described in which a heating wire is wrapped around the tube direct, in the air space between the liquid tube and the filter. Substances melting up to 200° can be investigated. (4) The Raman spectra are described of aceto-nitrile, *n*-butyronitrile, *iso*-valeronitrile, *iso*-capronitrile, ethylene cyanide, cyanacetic acid, *o*-tolunitrile, HCN, KCN, methyl isonitrile, ethyl isonitrile, phenyl isocyanate, *a*-naphthyl isocyanate, ethyl rhodanide, C_2H_5 SCN, C_4H_9 SCN, C_6H_5 SCN and *p*-$CH_3C_6H_4$ SCN. (5) The composition of the mustard-oils and isocyanates are discussed, and it is concluded that the Raman spectra decide in favour of



$\mathrm{R-N}\genfrac{}{}{0pt}{}{\equiv \mathrm{C}}{\searrow \mathrm{S}}$

for the former and $R-N=C=0$ for the latter. (6) The isonitriles have the structure $R-N\overset{\rightarrow}{=}C$, and HCN is a mixture of isomers with structures $H-C\equiv N$, and $H-N\overset{\rightarrow}{=}C$, the percentage of the latter being about ½ %, judging by the relative intensities of the lines. A. C. M.

3474. Raman Spectra of Organic Substances. Halogen Derivatives. A. Dadieu and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp*. 717–737, 1930.—Results are described of investigations of the spectra scattered by *n*-butylchloride, CBr_4, 1·3 dibromopropane, *a*-bromonaphthalene, *n*-propyl- and *n*-butyl-iodides, ethyl chloride, methylene bromide, methyl and ethyl iodides, iodobenzene, phosgene, and liquid chlorine. Some of the spectrograms were taken with the new small-scale apparatus of Dadieu which requires only 2½ cc. of liquid, and can be operated with a filter if required [see preceding Abstract]. A. C. M.

3475. Raman Spectra of Organic Substances. Chlorinated Hydrocarbons. M. Pestemer. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 9–10. *pp*. 667–683, 1930.—Describes the Raman spectra of ethylene- and ethylidene-chlorides, pentachlorethane, vinylchloride, *cis*- and *trans*- dichlorethylene, *n*-propyl- and *iso*-propyl-chlorides, chloracetol, propylidene-propylene- and trimethylene-chlorides, 1-, 2- and 3-chlorpropylene. A. C. M.

3476. Raman Effect for Liquid Hydrazine. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 305. *pp*. 1–7, *June*, 1931. *In English*.—Raman spectra of liquid hydrazine (H_2N-NH_2) and hydrazine hydrate ($N_2H_4 . H_2O$) are nearly the same under low dispersion, showing, besides the N–H frequency in triplet (3210, 3289, 3339), two lower frequencies due to the N–N single bond. Relationships to polymerised liquid ammonia (N_3H-NH_3) and ultra-violet dissociation of the vapour previously reported [see Abstract 3056 (1931)] are discussed. AUTHOR.

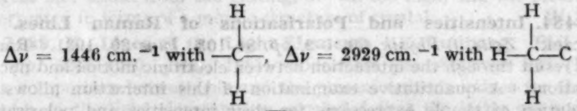
3477. Raman Spectra of Hydrocarbons. J. Weiler. *Zeits. f. Physik*, 69. 9–10. *pp*. 586–596, *June* 8, 1931.—Raman spectra are described of pentane, amylene, cyclopentane, cyclohexane, cyclohexene and benzene, the object of the work being to compare ring hydrocarbons with straight ones. The latter have more lines than the former. The ring hydrocarbons are characterised by a strong line between 800 and 1000 $cm.^{-1}$. A. C. M.

3478. Raman Spectra of Organic Sulphides. Part I. S. Venkateswaran. *Indian Journ. Phys.* 6. *pp*. 51–74, *June* 15, 1931.—The paper describes the results of investigation of the Raman spectra of methyl,

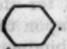
ethyl, propyl, butyl, isobutyl, and allyl sulphides and methyl and ethyl disulphides. Methyl sulphide belongs to a triangular model AX_2, and the oscillations of this system are discussed on dynamical considerations. The C–S linkage is associated with two frequencies, a sharp intense one at about 691 and a diffuse one at 746, which are not appreciably affected by changes in the nature of the group attached to the carbon atom or by the difference in the chemical bond between the sulphur and carbon atoms. The disulphides show a prominent new line at 512, which presumably represents the S–S oscillation. This value, which is distinctly lower than for ν obtained from fluorescence and absorption bands for sulphur vapour, points to the difference in the nature of the chemical bond between the sulphur atoms in S_2 and in the disulphides. A characteristic feature of C–S and S–S oscillations, revealed for the first time, is their peculiar tendency to split into components in ethyl and higher members of the series. A slight shift in the C–S oscillation of methyl sulphide is noticed in the disulphide. Allyl sulphide shows a prominent line at 1634 which is characteristic of ethylenic linkage. Differences in the character of the C–H band in the normal and corresponding iso-compounds are pointed out. AUTHOR.

3479. Raman Effect in Amino-Compounds. A. S. Ganesan and V. N. Thatte. *Zeits. f. Physik*, 70. 1–2, *pp*. 131–139, *June* 20, 1931.—The Raman spectra of the following aromatic animo-compounds are described: monomethyl-, dimethyl- and diethyl-anilines, *o*-, *m*- and *p*-toluidine and *o*-, *m*- and *p*-xylidine (1, 3, 5). The frequency shift 1604 cm.$^{-1}$ comes out in all these compounds, but with greater intensity than in benzene. The benzene shift 991 is very strong in the mono- and dialkyl-anilines, weak in the toluidines, and is lacking in the symmetrically arranged xylidines. 3432 cm.$^{-1}$ occurs only in the mono-alkyl anilines and not in the dialkyl anilines, and is therefore to be attributed to the N-H link. The infra-red absorption band 11·31 μ is lacking in all the compounds. A. C. M.

3480. Raman Spectra of Certain Organic Liquids. C. S. Morris. *Phys. Rev.* 38. *pp*. 141–146, *July* 1, 1931.—The Raman spectra of 19 organic compounds chosen from different chemical series have been measured. Frequency shifts are given and a relationship is shown between certain frequency shifts and molecular structure. In particular the frequency shift $\Delta\nu = 1024$ cm.$^{-1}$ recurs with the C–C structure, likewise $\Delta\nu = 1613$ cm.$^{-1}$ is associated with C = C,



$$\Delta\nu = 1446 \text{ cm.}^{-1} \text{ with } -\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{|}{\underset{|}{C}}}}-,\quad \Delta\nu = 2929 \text{ cm.}^{-1} \text{ with } H-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{|}{\underset{|}{C}}}}-C$$

and $\Delta\nu = 3054$ cm.$^{-1}$ with H— . It is suggested that anti-Stokes lines may have slightly greater frequency shifts than the corresponding Stokes lines. A comparison between Raman frequency shifts and infra-red absorption data is made. AUTHOR.

3481. Raman Effect in the Ultra-Violet. J. C. Ghosh and D. C. Kar. *J. Phys. Chem.* 35. *pp*. 1735–1744, *June*, 1931.—The lines 3131·7 and 3125·7 Å. in the mercury spectrum of almost equal intensity are used for scattering in liquids, since Raman lines can be easily picked out, having the constant frequency difference of 61·5 cm.$^{-1}$, thus aiding the correct allocation. The results are given for water, methyl alcohol, formic acid, ethyl formate, sodium formate, acetic acid, ethyl acetate, sodium acetate, ethyl benzoate, benzoic acid, sodium benzoate, trichloracetic acid, sodium trichloroacetate, monochloracetic acid, sodium-monochloracetate, malonic acid, sodium malonate and ethyl malonate. The results are discussed, in connection with the conclusions of Dadieu and Kohlrausch regarding frequencies to be connected with given linkages, and modifications of their conclusions are suggested. A. C. M.

3482. Raman Effect in Amorphous Solids. S. Bhagavantam. *Indian Journ. Phys.* 6. *pp.* 1–6, *June* 15, 1931.—The paper describes the results of a study of the Raman effect in ten samples of optical glasses. The crown glasses show the phenomenon much more feebly than the flints, a result analogous to that obtained in the experiments on classical scattering. Besides other weak bands, there are two prominent ones corresponding to about 500 and 1080 wave numbers which appear in practically all the samples. In those having lower refractive index, the former of these two is more intense. With increasing refraction, the latter gains in intensity over the former and becomes more prominent. The band at 1080 is represented by a prominent band extending from 8·5 to 10·7 μ in the infra-red absorption. AUTHOR.

3483. Raman Spectra of Inorganic Crystals. Part III. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 7–13, *June* 15, 1931.—Experiments with sulphur crystals at liquid air temperature show Raman lines due to 4358 excitation, which are absent at ordinary temperature. The relative intensities of the lines among themselves are different for the 4358 and 5461 excitations. Mercuric bromide crystals show a strong Raman line at 187 cm.$^{-1}$. Mercuric chloride crystals ($\nu_1 = 313$ cm.$^{-1}$ strong; $\nu_2 = 381$ cm.$^{-1}$ weak) show a slightly displaced and broadened line in methyl alcoholic solution (319 cm.$^{-1}$). With $HgCl_2$, $2NH_4Cl$, only one line is obtained either in the solid state or in solution (269 cm.$^{-1}$), while $HgCl_2$, NH_4Cl in solution gives two very broad lines ($\nu_1 = 274$ cm.$^{-1}$; $\nu_2 = 310$ cm.$^{-1}$) just resolved. The presence of only one complex salt $(NH_4)_2HgCl_4$ is hence shown by a characteristic Raman line, any $HgCl_2$ in excess of this giving its own line. The results are quite similar to those of Braune and Engelbrecht with K_2HgCl_4 and various other complex salt solutions. For Parts I and II see Abstract 1239 (1931). AUTHOR.

3484. Intensities and Polarisations of Raman Lines. G. Placzek. *Zeits. f. Physik*, 70. 1–2. *pp.* 84–103, *June* 20, 1931.—Raman lines result through the interaction between electronic motion and nuclear vibrations. A quantitative examination of this interaction allows the elucidation of simple expressions for their intensities and polarisation. The intensity is found to depend upon the state of binding of the atoms, being very weak for heteropolar bindings, and increasing in strength as the tendency is towards homopolar binding. Also the nature of the corresponding normal vibration is important; any frequency, corresponding to a normal vibration such that a symmetry operation upon it, *e.g.*, rotation through 180°, will alter the signs of the displacements without altering the energy, is missing as a fundamental in the Raman effect, and the more a normal vibration approximates to this, the weaker will be the corresponding frequency in the Raman effect. The rules deduced are applied to CCl_4, CO_2, CS_2, N_2O, SO_2, C_2H_2 and C_2H_4. A. C. M.

3485. Raman Spectra of Sulphuric Acid. R. M. Bell and W. R. Fredrickson. *Phys. Rev.* 37. *pp.* 1562–1564, *June* 15, 1931.—Concentrated H_2SO_4 gives a series of Raman lines which, with the exception of the 4566 Å. line, decrease in number and intensity with a decrease in concentration and finally disappear. At the point at which the above lines vanish, a broad line (4817 Å.) appears and persists in dilute solutions. At low concentrations the water bands are present. The 4566 Å. line is present at all concentrations of acid and increases in intensity with a decrease in concentration, but is missing in pure water. A line with the same wave-length (within experimental error) and intensity variation is found in HNO_3, and it is suggested that the two lines have the same origin. AUTHORS.

3486. Formula for an Absorption Jump. V. Posejpal. *Comptes Rendus,* 192. *pp.* 879–881, *April* 13, 1931.—Gives, without proof, a formula for the absorption jump occurring at a frequency ν_k. This quantity is defined as the limiting value when $\epsilon = 0$ of the quotient: (absorption coefficient at frequency $\nu_k + \epsilon$)/(absorption coefficient at frequency $\nu_k - \epsilon$). The value is given in terms of the atomic number of the atom and of the numbers of electrons in levels L_1, L_2, etc. A table is given in which experimental and theoretical values are compared. A detailed development of the formula is promised in a later paper. N. D.

3487. Absolute Wave-Lengths of the Copper and Chromium K-Series. J. A. Bearden. *Phys. Rev.* 37. *pp.* 1210–1229, *May* 15, 1931.—In the measurement of X-ray wave-lengths by ruled gratings two principal difficulties may account for the differences observed between the wave-lengths determined by this method and the use of crystal gratings, namely, periodic errors in the grating and geometrical divergence of the X-ray beam. It is shown how these effects may be eliminated, and it is concluded that ruled gratings can be used for precise measurements. Fine-glass gratings of different spacings and manufacture have been used to measure the wave-lengths of Cu and Cr K-lines. No systematic deviations between the gratings have been observed. The wave-lengths, as determined by the ruled gratings, are in all cases approximately 0·2 % too high. The error is thought to be either in the crystal spacing assumed or in the constants used to calculate this quantity. The values of e, m and h, calculated from crystal data on the basis of the X-ray wave-lengths and found from the grating, are all too high, and the results are interpreted in terms of a mosaic structure of crystals. W. V. M.

3488. K_α-Lines of the Light Elements. E. Rudberg. *Phil. Mag.* 11. *pp.* 1248–1250, *June,* 1931.—Söderman [see Abstract 867 (1931)] in a comparison between his and the present writer's values for the K_α-spectra of the light elements has concluded that the latter are too low. Rudberg now points out that his results depended on the measurements of the velocities of photoelectrons and that the final results of his paper are the only ones suitable for comparison, a fact overlooked by Söderman. A table is given showing that the agreement with Söderman's results is remarkably good when the final results are taken. H. H. Ho.

3489. Natural Widths of X-Ray Lines in the L-Series Spectrum of Uranium. J. H. Williams. *Phys. Rev.* 37. *pp.* 1431–1442, *June* 1, 1931.—The half-widths at half-maximum of the rocking curves in parallel positions of the double X-ray spectrometer with calcite crystals reflecting in the first order have been investigated as a function of wave-length, and this function is shown to be linear. The rocking curves of U $L\alpha_1$ in three different antiparallel positions of the instrument give a natural width which is practically independent of the dispersion. The natural widths of U $L\alpha_1$ and U $L\beta_1$ have been observed as a function of voltage, and no significant dependence was noted. The half-widths at half-maximum of twelve lines in the uranium L-series spectrum were studied and the results are:

Line U L.	α_1	α_2	β_1	β_2	β_3	β_4	β_5	β_6	γ_1	γ_2	γ_3	γ_6
$\Delta\lambda$ in X.U...	0·439	0·494	0·299	0·369	0·382	0·726	0·252	0·487	0·242	0·57	0·47	0·233
ΔV in volts..	6·56	7·20	7·17	8·04	9·40	16·1	5·94	9·71	7·96	19·7	16·2	8·18

Possible correlations with the electron transitions are suggested and the predominance of nuclear effects are evident from the greater widths of lines involving the elliptical orbit L_1. The observed widths are compared to the classical and quantum theory widths and the size of the nucleus necessary to explain the discrepancy is given. The possibility of observing the splitting of the energy levels due to nuclear spin as suggested by Breit is rejected. The actual shape of the line U $L\alpha_1$ has been investigated and found to approximate to that predicted by the classical theory. AUTHOR.

3490. Plane Grating Spectroscopy of Ultra-Soft X-Rays. J. A. Prins. *Zeits. f. Physik,* 69. 9–10. *pp.* 618–636, *June* 8, 1931.—Using a coarse grating (fifty lines per mm.), measurements of the K-series of the elements from O to Be have been made. By use of higher, and particularly of "negative" orders, an accuracy of about 1 % has been attained. The results agree well with the values given by Söderman [Abstracts 867 and 870 (1931)], except that the widths of the lines are rather larger than his. This is attributed to differences in the conditions of excitation. No confirmation is obtained of the fine structure reported by Faust [see Abstract 4040 (1930)]. The intensity, dispersion and resolution in the various orders are investigated, and a simple formula is given for the maximum resolution obtainable with a given apparatus. The process of "total reflection" at the grating elements is discussed in detail.
C. B. A.

3491. Complexity of L-Series of Barium. V. Dolejšek and J. Kubiček. *Comptes Rendus,* 192. *pp.* 1369–1370, *June* 1, 1931.—An emission band similar to the $K\beta'$ band of Mn has been found in the neighbourhood of the principal L-lines of Ba, but on the side of shorter wave-lengths. The $K\beta'$ line of Cu photographed on the same plate is situated on the longer wave-length side of the principal line. This rules out the explanation that the phenomenon is a broadening of the line due to penetration into the crystal grating. The separation of the $K\beta'$ from the $K\beta_1$ line confirms the results previously obtained with Mn. The intensity relationships for the lines obtained from different chemical compounds suggest that the origin of the satellite is related to the chemical composition. Similar measurements have also been made on In and Cs. C. B. A.

3492. Spectroscopic Search for Element 61. S. Takvorian. *Comptes Rendus,* 192. *pp.* 1372–1373, *June* 1, 1931.—The arc spectra of

V.
19

rare earth fractions intermediate between neodymium and samarium, previously submitted to X-ray analysis [see Abstract 3124 (1931)], are now investigated photometrically, and compared with those of fractions prepared synthetically from neodymium and samarium. The spectra observed in each case are identical, indicating the absence of any lines due to the element 61. C. B. A.

3493. Partial Absorption of X-Ray Quanta. A. J. Alichanow and L. A. Arzimowič. *Zeits. f. Physik*, 69. 11–12, *pp*. 853–856, *June* 13, 1931.—A beam of X-rays was analysed spectrometrically after passing through layers of paraffin, naphthalene, graphite or water. No difference could be observed between the spectra obtained (Kα-line of Cu) with or without the absorbing substance in position. For the quanta employed, therefore, there is no appearance of the phenomenon of partial absorption found by B. B. Ray. C. B. A.

3494. Absorption Coefficient of Lead for Hard X-Rays. R. Jaeger. *Zeits. f. Physik*, 69. 9–10. *pp*. 565–577, *June* 8, 1931. *From the Reichsanstalt.*—Measurements of the absorption coefficient of lead have been made by Herrmann and Jaeger using 200, 250, 300, 350 and 400 kV, using the end-radiation method of Barkla and White. The values obtained are compared with those of Allen, of Glocker and Reuss and with those obtained for the weak component of the γ-radiation of RaC. All these results can be correlated by $\mu_{Pb} = \frac{64\cdot5 \times 10^4}{V^2} = 0\cdot424 \times 10^4\lambda^2$, where V is in kV and λ in Å. If the absorption coefficient is regarded as the sum of a true absorption coefficient, and a scattering coefficient, the dependence of the scattering coefficient on the wave-length can be deduced. The classical scattering coefficient is 20·2, in good agreement with older measurements of Crowther, Barkla and Sadler. In the spectral region investigated, the results are in better agreement with Bothe's formula than with Compton's. The absorption coefficient can be expressed as $\mu_{Pb} = 22\cdot7 \times 10^3 \,.\, \lambda^3 + 2\sigma_0 \,.\, e^{-3\cdot5a}$, where the first term is the true absorption, the second the scattering, and a is $\frac{0\cdot0242}{\lambda}$. Finally the author agrees with Ellis and Aston that for high frequencies the true absorption may not follow the λ^3 law. A. C. M.

3495. X-Ray Wave-Length Change by Partial Absorption. J. M. Cork. *Phys. Rev.* 37. *pp*. 1555–1558, *June* 15, 1931.—The attempt to repeat the experiments of Ray [see Abstract 1561 (1931)], in which a change in wave-length occurred in an X-ray beam upon passage through an absorbing substance, has been continued. In the previously reported experiments CuK radiation was passed through absorbers of boron, beryllium, carbon, nitrogen and oxygen. These same absorbers have been retried with tungsten L radiation with a spectrometer of greater dispersion. Although it should have been possible to observe a modified line of 1/3000 the intensity of the unmodified, in no case has any trace of a modified line been observed. AUTHOR.

3496. X-Ray Absorption Coefficients of Mercury Vapour in the Region of its L-Absorption Discontinuities. F. M. Uber. *Phys. Rev.* 38. *pp*. 217–224, *July* 15, 1931.—An apparatus is described which is suitable for absorption measurements up to 2 Å. or more. The absorber, which was in the form of superheated vapour whose density could be calculated on the assumption of perfect gas behaviour, was contained in an all-glass chamber. The windows were constructed of thin glass films in such a way as to withstand atmospheric pressure from either side. The mass absorption coefficients, μ/ρ, of mercury in the wave-length region 0·74 to 1·4 Å. were determined by an ionisation method. They were found to obey the relation $\mu/\rho = A\lambda^c$, where the constants A and c vary from branch to branch of the μ/ρ, λ curve. The value of c is 2·56 on the short and 2·66 on the long wave-length side of the L-discontinuities. The magnitudes, δ, of the three L-absorption discontinuities, where δ is defined as the ratio of μ/ρ (the scattering coefficient being neglected) on the short and long wave-length sides of an absorption limit, are $\delta L_I = 1{\cdot}18$, $\delta L_{II} = 1{\cdot}39$, $\delta L_{III} = 2{\cdot}45$. AUTHOR.

3497. Effect of Piezoelectric Oscillation on the Intensity of X-Ray Reflections from Quartz. G. W. Fox and P. H. Carr. *Phys. Rev.* 37. *pp.* 1622–1625, *June* 15, 1931.—In an attempt to determine the amplitude of vibration of the ions in a quartz lattice brought about by piezoelectric oscillations, a series of Laue photographs have been made of both Curie and thirty-degree-cut plates, using the white radiation from a Coolidge universal tube. This tube had a tungsten anode and carried a current of 4 mA at 95 kV. Eastman duplitised X-ray film was used with no sensitising screens. On examination, the patterns produced by each plate, oscillating and non-oscillating, appear identical except in one respect; the pattern of the oscillating plate is several times as intense as that of the non-oscillating. A four-hour exposure of a non-oscillating plate to radiation of the above-mentioned type produces but the rudiments of a pattern, whereas the same plate oscillating produces a very beautiful intense pattern for the same time of exposure. The effect does not depend on the mode of vibration, but does depend on the amplitude. Further work is in progress which it is hoped will establish the cause of this peculiar intensity difference. AUTHORS.

3498. X-Ray Interference Measurements of Interatomic Distances in Benzene and Carbon Tetrabromide Molecules. E. Rumpf. *Ann. d. Physik*, 9. 6. *pp.* 704–714, *May* 28, 1931.—X-ray interference measurements have been carried out on C_6H_6 and CBr_4 in C_6H_6 solution. The C—C distance in C_6H_6 is found to be 1·36 Å.: the length of a side of the tetrahedron in CBr_4 is 3·53 Å., and the C—Br distance 2·16 Å. All these values are accurate to ± 1 %. [See also Abstract 519 (1931).]

F. J. W.

3499. Breadth of Compton Modified Line with Double Crystal Spectrometer. A. Hoyt and J. DuMond. *Phys. Rev.* 37. *pp.* 1443–1451, *June* 1, 1931.—Three experimenters using the double-crystal spectrometer have recently reported very much narrower structure for the Compton modified line than the structure observed photographically by DuMond and Kirkpatrick [see Abstract 1930 (1931)] with the multi-crystal spectrograph whose resolution was entirely adequate to reveal such a narrow structure. The authors have repeated the experiment, using a similar double-crystal spectrometer. The results obtained are in agreement with DuMond and Kirkpatrick. The conclusions drawn are: (1) The Compton modified line due to Mo Kα radiation scattered by graphite at angles of 165° ± 10° and examined with the double-crystal spectrometer has a breadth of from 21 to 22 XU at half-maximum height; (2) under the above conditions there is no appreciable separation of the Kα doublet in the shifted position; (3) no fine structure exists in the scattered spectrum of intensity greater than one-fifth the modified line intensity; (4) the ratio of modified to unmodified line intensity is estimated at (7·3 : 1); (5) there appears to be no essential difference between the results obtained with the single-crystal, multi-crystal and double-crystal spectrometers in the study of this problem. AUTHORS.

3500. Scattering of X-Rays by Gases and Crystals. G. E. M. Jauncey. *Phys. Rev.* 38. *pp.* 1–5, *July* 1, 1931.—Recently A. H. Compton and Jauncey and Harvey have obtained theoretical formulæ for the scattering of X-rays by gases and crystals respectively. By means of these formulæ f' values can be calculated. From measurements on the diffuse scattering by rock-salt, Jauncey and Harvey have calculated f' values for the average atom, or $(Na^+ + Cl^-)/2$, in rock-salt. Wollan has also recently obtained f' values for neon and argon. The f' values for the average of neon and argon, or $(Ne + A)/2$ are compared with those for $(Na^+ + Cl^-)/2$ and an excellent agreement is found. Also these two sets of experimental f' values are shown to be in excellent agreement with the quantum mechanics model of Waller and James. It is shown that the difference between f' and f, the true atomic structure factor, is not negligible, and that the error in assuming f to be given by f' may be as large as 20 or 30 % at large values of $(\sin \phi/2)/\lambda$. Also it is pointed out that only f, but not f', values may be used in the Fourier analysis method of unravelling crystal structure. [See also Abstract 3114 (1931).] AUTHOR.

3501. Experimental Electron Distributions in Atoms of Monatomic Gases. E. O. Wollan. *Phys. Rev.* 38. *pp.* 15–22, *July* 1, 1931. The radial electron distribution in the atoms of helium, neon and argon is calculated from the writer's recent data for the intensity of X-rays scattered by gases [see Abstract 2709 (1931)]. These curves are found to be in good agreement with similar curves derived from wave mechanics. They represent the electron distribution for the atom in a state of rest, and hence show more detail than similar curves calculated with the aid of crystal reflection data. In the case of neon, the experimental data are sufficiently complete to separate the K and L electrons. The smaller radii of these levels in argon make such a resolution impossible for the wave-length of the X-rays used. A comparison of the U curve for argon and with the same curve for the chlorine ion from NaCl at 0° K. shows the presence of zero-point energy for the ion in the space lattice of the crystal. AUTHOR.

3502. Atomic Scattering Power of Copper and Oxygen in Cuprous Oxide. G. A. Morton. *Phys. Rev.* 38. *pp.* 41–44, *July* 1, 1931.—Atomic F-curves for the copper and oxygen in Cu_2O have been obtained for Kα radiation of copper from a measurement of the principal powder reflections. The F-curves are compared with the F-curves for metallic copper and for oxygen in NiO and found to be identical. AUTHOR.

RADIOACTIVITY.

3503. Thermodynamical Principles of Nuclear Phenomena. G. I. Pokrowski. *Phys. Zeits.* 32. *pp.* 374–377, *May* 1, 1931.—An equation somewhat resembling the mathematical statement of Boltzmann's principle, $S = K \log W + c$, is applied to discuss nuclear atomic transformations, and is found to give reasonably good agreement between calculated and determined values of the relative abundance of the elements. The theory is also applied to the discussion of radioactive transformations and stellar masses. J. S. G. T.

3504. Radioactive Disintegration according to the Relativistic Wave Equations. S. Gupta. *Zeits. f. Physik*, 69. 9–10. *pp.* 686–698, *June* 8, 1931.—The question of the disintegration of radioactive substances is worked out according to Dirac's relativistic wave equations, using the method of v. Laue and Sexl. It appears that using the relativistic calculations, the disintegration constant is greater than that obtained from Schrödinger's equation, and that this increase is somewhat greater for small velocities than for larger ones. H. N. A.

3505. Emanation Yield of Radioactive Luminous Colours. P. M. Wolf and N. Riehl. *Zeits. f. techn. Physik*, 12. 4. *pp.* 203–205, 1931.—Investigation was made of the emanation yield with the various types of radioactive luminous colouring matters. Hence is deduced the amount of emanation concentrations which occur in the spaces in which radioactive colours are used, and the question is discussed whether there exists a possibility of injury to health. It was found that radium luminous colours give up about 30 % of the existing emanation to the outer air. The emanation yield rises considerably at close places in the air and with dampness. The emanation product is smaller with mesothorium luminous colours and only amounts to a tenth of that with radium colours. The pure radiothorium colours are free of any emanation product. With radium luminous colours, large amounts of emanation are set free and injurious effects on health seem to be possible. J. J. S.

3506. Recoil Atoms in Rare Gases. L. Goldstein. *Comptes Rendus*, 192. *pp.* 1373–1376, *June* 1, 1931.—In fields below saturation value the yield of activation on the negative electrode is the same (32 % compared with 83 % for air) for each of the gases He, A, Ne, and is independent of the pressure. On the positive electrode it increases slightly with pressure. In a field above saturation value, the activation on the kathode at a given pressure as the field strength increases falls to a distinct minimum before increasing rapidly when the field exceeds that at which ionisation by collision begins. The inverse process occurs at the anode. These results are held to indicate that (1) below the saturation field the yield of activation is independent of the ionisation potential of the gas, (2) in fields above 40 volts per cm. groups of atoms existing in the gas are swept to the negative electrode, (3) the electro-affinity of the gas influences the yield. [See also Abstract 1577 (1931).] C. B. A.

3507. Electrochemical and Chemical Behaviour of Polonium in Tartaric Acid Solution. M. Haïssinsky. *Comptes Rendus*, 192. *pp.* 1448–1451, *June* 8, 1931.—Using Joliot's method [see Abstract 2558 (1927)], on electrolysing a solution of polonium of concentration 2×10^{-9} *N* in normal tartaric acid, the velocity of deposit is only about one-fourth that in acetic acid under similar conditions. There are two critical potentials, 0·38 and 0·03 volts [see Abstract 1896 (1930)]. A similar solution but of concentration $7 \cdot 6 \times 10^{-9} N$, on centrifugation lost no polonium, but when made of pH7–8 by addition of ammonia it lost 42 % in an hour. It is inferred that polonium forms an unstable soluble complex with tartaric acid similar to that formed by bismuth, the polonium being present in two forms of different valencies. C. A. S.

3508. New Gaseous Compound of Polonium. (Mme.) Irène Curie and M. Lecoin. *Comptes Rendus*, 192. *pp.* 1453–1454, *June* 8, 1931.—If nickel on which polonium has been deposited [see Abstract 2414 (1928)] is heated to a red heat in a quartz tube in a current of nitrogen, the tube dipping into an acid solution, practically all the polonium condenses on a cool part of the tube. If, however, the nitrogen be replaced by a mixture of CO_2 and CO, only a portion can be so recovered, and that distributed all along the tube, the rest, which may amount to half, is found in the acid, indicating the formation of a gaseous compound, possibly a polonium carbonyl. C. A. S.

3509. New Reaction of Polonium. M. Haïssinsky. *Comptes Rendus*, 192. *pp.* 1645–1647, *June* 22, 1931.—If a solution of polonium in dilute nitric acid (0·1–0·5 N), to which pyrogallol had been added some time previously, be electrolysed, deposition of polonium on the kathode ceases, and the polonium can be separated almost completely by centrifuging. It is inferred that the polonium is first reduced to the trivalent state, and then forms an insoluble compound with pyrogallol, similar to that formed by bismuth, $C_6H_3O_3Bi$. Tellurium under similar circumstances gives no such compound. C. A. S.

3510. Variation in Range of α-Particles of Polonium in Different Gases. Nahmias. *Comptes Rendus*, 192. *pp.* 1451–1452, *June* 8, 1931.—Determined by means of Irene Curie's method [see Abstract 2530 (1925)], the straggling coefficients of the α-rays of polonium in air, O_2, A and CO_2 are respectively 0·0200, 0·0250, 0·0190 and 0·0280. The ratio of the most probable ranges for such particles of thorium C and polonium in air at 15° and 760 mm. is 1·20–1·21. Short-range particles of thorium C form a substantial proportion of the total emitted. [See Abstract 3083 (1929).] C. A. S.

3511. Anomalous Scattering of α-Rays. M. Muskat. *Phys. Rev.* 38. *pp.* 23–31, *July* 1, 1931.—The well-known wave-mechanical expression giving the scattering function, to a first approximation, as an integral over the potential field of the scattering system, is inverted so as to give the potential field as an integral over the observed intensity of scattering. This is applied to the problem of determining the potential field causing the anomaly in the α-ray scattering by Mg as observed by Rutherford and Chadwick [see Abstract 769 (1926)] and Bieler. This anomaly, defined as the difference between the observed scattered intensity and that predicted theoretically on the basis of a Coulomb potential field, is represented by an empirical analytic expression in two different ways. It is shown that the potential fields for both representations as derived by the above-mentioned inversion are essentially the same, and their form depends almost entirely on the single fact that the curve for the anomaly shows a marked minimum. In magnitude, this potential field never

exceeds 10 % of the Coulomb potential. It oscillates in sign, and falls off very rapidly as one recedes from the scattering atom. It is pointed out that the small numerical value and oscillatory character of this potential field is in marked contrast to the assumptions that have been made hitherto, most of which have been that the potential is of the form of $1/\rho^n$, $n \geq 2$, ρ being the distance from the centre of the nucleus. It is finally noted that if the derived potential field is given an electrostatic origin it is equivalent to a series of shells of alternating sign of charge with a spacing of the order of $1 \cdot 5 \times 10^{-13}$ cm. This is just the inference drawn by Rutherford and Chadwick as to a possible cause for the anomaly.
AUTHOR.

3512. Absorption of β-Rays by Matter. G. Fournier and M. Guillot. *Comptes Rendus*, 192. *pp*. 1100–1102, *May* 4, 1931.—When the source of β-rays and the absorbent metal are placed so that varying proportions of the unabsorbed radiation reach the ionisation chamber, the dispersion does not affect the absorption curve (save at its commencement), and μ/ρ is correctly calculated from the slope of the logarithmic curve, provided that the superficial density is not less than 50 mg./cm.^{2}. μ/ρ is therefore a definite quantity, depending solely on the nature of the absorbent and of the β-rays. This is further confirmed by measurements of the intensity of β-rays reflected at 45° from screens of varying thickness.
C. A. S.

3513. γ-Rays of Potassium. F. Běhounek. *Zeits. f. Physik*, 69. 9–10. *pp*. 654–663, *June* 8, 1931.—The γ-radiation from potassium discovered by Kolhörster was analysed by measurement of the ionisation effect produced by 93 kgm. of KCl, in a large ionisation chamber with a compensation arrangement. A homogeneous γ-radiation, with the absorption coefficient $\mu_{Pb} = 0 \cdot 58$ cm.$^{-1}$, was found. The intensity of this radiation is $1 \cdot 3 \times 10^{-10}$ of the intensity of the harder part of the γ-radiation of RaC. From the formula of Klein and Nishina the wavelength of this radiation has been calculated as 13·3X. Its relation to the previously known β-radiation of potassium is considered. H. N. A.

3514. Residual Ionisation in Air at High Pressures, and its Relation to Cosmic Radiation. J. W. Broxon. *Phys. Rev*. 37. *pp*. 1320–1337, *May* 15, 1931.—Measurements of the residual ionisation in air were made with a new spherical chamber of 13·8·l. capacity at pressures up to 170 atmospheres, at an altitude of 5400 ft. Lead and water shields were used. The slopes of the ionisation-pressure curves continued to decrease at the higher pressures, becoming zero in the neighbourhood of 130 to 140 atmospheres. The ionisation-pressure relation and the effects of shielding are explained on the basis of the production of ions solely by secondary radiations excited in the walls of the vessel by the cosmic penetrating radiation. The theoretical consequences of such an assumption are discussed.
AUTHOR.

HEAT.

3515. Thermal Diffusion Problem for a Solid in Contact with a Stirred Liquid. T. E. W. Schumann. *Phys. Rev.* 37. *pp.* 1508–1515, *June* 1, 1931.—A cylindrical solid of length a in a direction x and of arbitrary cross-section normal to x is in contact on its plane face $x = a$ with a well-stirred liquid. The face $x = 0$ of the solid and the lateral surface are impervious to heat. The liquid extends from $x = a$ to $x = a + b$. At $x = a + b$ the liquid is in contact with a source of heat at the constant temperature θ, the transfer of heat from this source being proportional to the difference in temperature between the outside source and the liquid. If the initial temperatures of solid and liquid are given, the problem of the temperature distribution at any subsequent time can be obtained by means of a modification of the well-known Fourier analysis.
AUTHOR.

3516. Friction, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part XV. Friction of H_2, N_2O, CO_2 and C_3H_8, and their Binary Mixtures. M. Trautz and F. Kurz. *Ann. d. Physik*, 9. 8. *pp.* 981–1003, *June* 17, 1931.—The friction coefficients of the pure gases H_2, CO_2, N_2O and C_3H_8 were measured at temperatures of 26·9°, 126·9°, 226·9° and 276·9° C. The value obtained at 15° C. agreed with that of other authors completely, whilst the values of the coefficient for CO_2 and N_2O were exactly the same and bore a constant ratio of 1·81/1 to the value for C_3H_8. The friction isotherms are recorded for various mixtures of the above gases at the same temperatures. The temperature exponent n and the Sutherland constant C are calculated over the entire range given above. The friction coefficients of the gases CO_2, N_2O, NH_3, H_2S, SO_2 (and perhaps Cl_2) follow a definite mathematical expression, which is given. The closed-triangle law follows in general (except for H_2/C_3H_8), and good agreement is established between calculated and experimental values of q. The other aspects of the various constants and variables involved are discussed in detail.
S. G. B.

3517. Friction, Thermal Conductivity and Diffusion in Gaseous Mixtures. Part XVI. Friction of H_2, CH_4, C_2H_6, C_3H_8 and their Binary Mixtures. M. Trautz and K. G. Sorg. *Ann. d. Physik*, 10. 1. *pp.* 81–96, *June* 24, 1931.—The present contribution deals with the measurement and the calculation of the coefficient of friction n. The friction constant was measured for air, H_2, CH_4, C_2H_6, C_3H_8, by the transpiration method at 20°, 100°, 200° and 250° C. The values for air, hydrogen and the organic gases were in entire agreement with the earlier results. The Sutherland constant C and the temperature exponent n were derived for the above gases, and the weak value of C in the neighbourhood of T_k was established. The value of $M\theta$ appeared to be furnished for the homologues by the equation

$$M\theta = 52 \times 2/\{(OZ - DOZ/2)/2\}$$

where OZ represents the sum of the numbers signifying structural arrangement, and DOZ the same for the group CH_2. The friction constants of binary mixtures of H_2 with the three first paraffins were measured. They show maxima in the η/x diagram which lie on a straight line through $\eta_{H_2} = 0$, and which is steeper in inclination the higher the paraffin. The mixtures of the paraffins were also measured and exhibited no maxima under similar conditions to the above. The average value of q, the mean factor F and the middle member of the expression, obtained by symmetrical ordinates, proved independent of the concentration. The empirical equation

$$F = \sqrt[8]{\frac{Ms/Zs}{Ml/Zl}} \Big/ \frac{Ms/OZs}{Ml/OZl},$$

has also been proved valid for the gases under test when suitable adjustments were made for H_2 distribution, where M is the molecular weight for s (heavy) and l (light) gases, and Z the atomic number with OZ having the usual meaning as the sum of the figures indicating the structural arrangement of the atom. S. G. B.

3518. Theory of Heat Exchange and Recuperation. G. Ackermann. *Zeits. f. angew. Math. u. Mechanik,* 11. *pp.* 192–205, *June,* 1931.—A theory is developed mathematically of heat recuperators, based on the assumptions that the thermal conductivity of the gas stream is zero in the direction of flow of the stream and has a definite value in the transverse direction. The integral equation derived as a solution is transformed by partial integration into a form applicable to practical calculation. Illustrative calculations relating to temperature distribution on the refractory material of the recuperator and the efficiency of heat recovery in blast furnace recuperators are given. J. S. G. T.

3519. Warming of a Room. A. F. Dufton. *Phil. Mag.* 11. *pp.* 1233–1235, *June,* 1931.—In a previous paper dealing with the influence of the fabric of a wall [see Abstract 3482 (1930)], reference was made to the well-known fact that some rooms are not readily warmed. Experiments are now described on the warming of a room by means of a gas-fire burning 0·2 therm per hr., the records being taken with a eupatheoscope 8 ft. from the fire. The data were obtained for the unpanelled and oak-panelled room respectively, and showed that the latter was warmer after half an hour than the former after an hour and a quarter. In a room used for dining, a gas-fire tends to give an unsuitable distribution of warmth. H. H. Ho.

3520. Measurement and Recording of Rapid Fluctuations of Air Speed with Very Thin and Short Hot Wires. M. Ziegler. *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 663–672, 1931.—A five-stage valve amplifying circuit, connected with a Wheatstone bridge, for measuring and recording the out-of-balance difference of potential at the ends of a heated platinum resistance wire of length about 1 mm. and diameter 0·003–0·005 mm., prepared from Wollaston wire, is described. J. S. G. T.

3521. Air Thermostat. W. H. J. Vernon. *Faraday Soc., Trans.* 27. *pp.* 241–247, *June*; *Disc.,* 577–582, *Sept.,* 1931.—Constructional and test details are given of an air thermostat for the accurate control of temperature over long periods. The thermostat consists essentially of a glass tube, made grid-fashion, filled with toluene. The working floor of the air chamber measures 79 in. by 30 in., and tests by a Beckmann thermometer over this area show a maximum "spatial variation" of 0·015 at a controlled temperature of 25° C. Time variations did not exceed 0·005° and temporary disturbances such as opening of a door for 3 or 4 min. are quickly compensated and eliminated within 20 sec. S. G. B.

3522. Distribution of Temperature in a Right Section of a Filament Plate. G. Ribaud. *Comptes Rendus,* 192. *pp.* 1205–1207, *May* 18, 1931.—The problem is of importance on account of the use of tungsten lamps for pyrometry. The paper is mainly mathematical, and an expression is given for the distribution of temperature over the section. The distance from the edge of the filament for which the temperature does not differ by more than 0·1 of the temperature gradient from centre to edge can readily be determined from an equation given. G. E. B.

3523. Melting Points and Heats of Crystallisation of the Normal Long-Chain Hydrocarbons. W. E. Garner, K. van Bibber and A. M. King. *Chem. Soc., J. pp.* 1533–1541, *June,* 1931.—The heats of crystallisation Q of a number of straight-chain paraffin hydrocarbons ranging from $C_{22}H_{46}$ to $C_{35}H_{72}$ have been determined. Both Q and Q/T bear a linear relationship to the number of carbon atoms, *n*, in the chain, and an equation has been derived for the setting point T in terms of *n*; the convergence temperature is 135° C., compared with 116° C. for the even fatty acids and 112° C. for the odd fatty acids. The compounds studied exist in two modifications, and the heat of transition lies between 6 and 11 k.-cal. per mol. The introduction of one methylene group causes an increase of the heat of crystallisation of the α and β forms of 0·608 and 1·0 k.-cal. per mol., respectively, compared with 1·03 k.-cal. for the fatty acids. H. F. G.

3524. Melting Curve of Hydrogen to 450 Kg./Cm.² W. H. Keesom and J. H. C. Lisman. *K. Akad. Amsterdam, Proc.* 34. 5. *pp.* 598–601, 1931. *Comm. No.* 213*e from the Phys. Lab., Leiden.*—The method used was the same as in earlier measurements [see Abstract 1912 (1929)], which extended to only one-half of the present range of pressures. Above 250 kg./cm.^{2} the temperature is above the normal boiling point of hydrogen, so that a cryostat [see following Abstract] had to be constructed in which the hydrogen boils at pressures up to 5 atmospheres absolute, *i.e.*, at temperatures from 20·3° to 27·5° K. The results extend from the triple point at 13·95° K. (pressure 0·1 kg./cm.^{2}) to 24·66° K. (pressure 449·4 kg./cm.^{2}). J. H. A.

3525. Cryostat for Temperatures between 20·3° and 27·5° K. W. H. Keesom and J. H. C. Lisman. *K. Akad. Amsterdam, Proc.* 34.5. *pp.* 602–604, 1931. *Comm. No.* 213*f from the Phys. Lab., Leiden.*—Describes a cryostat in which hydrogen may evaporate at any pressure from 1 to 5 atmospheres. The charge is sufficient to allow of about 30 min. continuous working at any one temperature. [See preceding Abstract.] J. H. A.

3526. Adiabatic Calorimetry at Higher Temperatures. W. Kangro and R. Grau. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 85–92, 1931.—An adiabatic calorimeter for work at high temperatures has been designed from an earlier apparatus [see Abstract 2432 (1928)] and its utility tested in the transformation reaction of opianic acid oxime anhydride to hemipinimide. The heat of transformation is found to be 52·5 ± 0·1 k. cal./mol., the value from the heats of combustion being 52·5 ± 0·8 k. cal./mol. H. H. Ho.

3527. Specific Heat of Quasi-free Electrons. E. C. G. Stueckelberg and P. M. Morse. *Zeits. f. Physik*, **69.** 9–10. *pp.* **666–677**, *June* **8, 1931.**—Shows that if the electrons of a metal are not free, that is, if the energy continuum of the " permitted " states is divided up by regions of " unpermitted " states, deviations are produced from Sommerfeld's expression for the specific heat. In a case which is described as " filled up " (*aufgefüllt*) the specific heat increases, not linearly, but only exponentially with the temperature. H. N. A.

3528. Specific Heat Data on Boron Trioxide Glass. S. B. Thomas and G. S. Parks. *J. Phys. Chem.* **35.** *pp.* **2091–2102**, *July*, **1931.**—A fairly accurate " radiation " calorimeter has been developed for use between room-temperature and 500° C. With this apparatus the heat capacities of boron trioxide glass and liquid have been measured between 35° and 350° C. with a probable absolute error of less than 4 % and with a reproducibility for comparative purposes of about 0·5 %. The heat capacity curves obtained (*a*) by heating a " metastable " glass, (*b*) by heating a well annealed glass and (*c*) by slowly cooling the liquid to produce the annealed glass have been compared and discussed. AUTHORS.

3529. Quantitative Humidification of Air. W. H. J. Vernon and L. Whitby. *Faraday Soc., Trans.* **27.** *pp.* **248–254**, *June*, **1931.**—Various laboratory methods for humidification of air are critically discussed, including the Dreschel wash bottle, the Babo tower and the steam method. A method is outlined and its performance discussed in detail for the preparation of atmospheres of any desired relative humidity. This method is one of admixture in the correct proportions of dry and saturated air into a previously evacuated vessel. Complete saturation was rapidly effected by the admission of steam into an air-stream, afterwards condensing out the excess moisture under controlled thermostatic conditions. Records are appended of quantitative results at various humidities. S. G. B.

3530. Thermal Properties of Toluene. K. Nesselmann and F. Dardin. *Wiss. Veröff. a. d. Siemens-Konzern*, **10.** 2. *pp.* **129–154**, **1931.**—The following determinations have been made for toluene for pressures up to 10 atmospheres (absolute) and temperatures up to 275°: vapour-pressure curve, specific heat of vapour and liquid, specific gravity and volume of liquid, and heat of evaporation. Comparison of the resulting data on the basis of various thermodynamic relationships reveals various discrepancies, which do not, however, exceed 10 %. The equations deduced cannot be used for extrapolation purposes, but the results show that the Benson process can be successfully applied in the case of toluene. The complications involved in intermediate superheating do not arise, since the toluene vapour, when expanded from the critical pressure under only slight superheating, does not touch the wet region, and since the critical pressure is only 43 atmospheres (absolute). The theoretical thermal efficiency does not appear to be obtainable, as is the case with steam for the same temperature drop. For special purposes, however, when it is possible to condense at very low temperatures (below 0°), toluene could probably be employed for small outputs and the thermal efficiency theoretically attainable should be of the same order of magnitude as that given by steam under normal conditions. T. H. P.

SOUND.

3531. Alimentation of Oscillations. A. Sellerio. *N. Cimento,* 8. *pp.* 133–151, *April,* 1931.—Studies the case of oscillations where there is both a resistance and a constant source of energy, of the nature of a clock weight. Oscillations cannot take place if the system have only one degree of freedom. The conclusions are rather detailed; but they throw light on the violin bow. A. D.

3532. Mechanical Recording of Sounds. E. Huguenard. *Comptes Rendus,* 192. *pp.* 1084–1085, *May* 4, 1931.—The sound is recorded on a flexible band of celluloid or cellulose passing at a speed of between 1 m. and 1 mm. per sec. The record is made by incisions produced by a tool in the shape of a chisel at right angles to the direction of the band. It is claimed that a 5-cm. photographic record can be compressed into 1 mm E. E. F. d'A.

3533. Threshold of Hearing. Part I. Measurement of the Excitation Threshold with Resonance Telephones. E. Waetzmann and H. Heisig. *Ann. d. Physik,* 9. 8. *pp.* 921–973, *June* 17, 1931.—The experiments deal with determinations of (i) the efficiency of a series of resonance telephones, (ii) the threshold of hearing when the telephone is held against the ear, (iii) the threshold when the telephone is used as a source of sound at a distance from the ear. A simplified formula is obtained for the total acoustic efficiency of electromagnetic telephones used at their resonance frequencies, and a set of telephones is used in which these frequencies vary from 80 to 4300. The acoustic energy output of a given telephone with given exciting current varies from one ear to another, and the variation may amount to 100 %. The sensitiveness of hearing, measured as the reciprocal of the ergs per sq. cm. per sec., is plotted with the frequency for tests made on five ears. There is a maximum sensitiveness about frequency 1000, up to which frequency the measurements agree with those of E. Meyer, whose curve of sensitiveness lies between those of Wien and of Fletcher and Wegel. When the sensitiveness was measured by a telephone at a distance from the ear, in an acoustic chamber, the results agreed well with those found by the first method. G. E. A.

3534. Experimental Study of Kundt's Tube Dust Figures. E. Hutchisson and F. B. Morgan. *Phys. Rev.* 37. *pp.* 1155–1163, *May* 1, 1931.—An experimental study of the dust striations in a Kundt's tube has been carried out using a loud-speaker, operated from a vacuum tube oscillator, as a source of sound. It is found that the position of the vibrator for maximum agitation of the dust is different for the case in which a loud-speaker is used from that obtained when a stroked rod is used. The formation and behaviour of the striations are described in detail. It is found that the spacing between the striations increases with the intensity of sound, decreases with an increase in pressure of the gas, and decreases with an increase in density of the dust material. A minimum spacing is found when the size of the dust particles is changed. The relation suggested by Cook that the ratio of the separation of the striations to the mean free path is a constant was tested, but the results obtained indicated that such a simple relation does not exist. AUTHORS.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

3535. Saturation of the After-Effect of Quartz. H. Saegusa and S. Shimizu. *Tohoku Univ., Sci. Reports,* 20. *pp.* 1–14, *March,* 1931.—The importance of the anomalous after-effect of dielectrics in their apparent resistivity was discussed by the authors in a former paper [see Abstract 3161 (1929)] in relation to observations on the characteristics of crystals and the study of the mechanism of electrical conduction in dielectrics. In the present paper the variations of the recovery time of the after-effect and the apparent conductivity due to the after-effect of quartz, cut perpendicular to its optical axis, are studied with the various charging times of the previously applied potentials and with various measuring potentials. It was found that the recovery time and the apparent conductivity increase with the charging time and tend to produce saturation from about 50 min. charging, and decrease as the measuring potential increases up to the previously applied potential.
J. J. S.

3536. Anomalous After-Effect of Dielectrics in their Apparent Resistivity. S. Shimizu. *Tohoku Univ., Sci. Reports,* 20. *pp.* 15–35, *March,* 1931.—Several crystalline dielectrics were examined to test whether the anomalous after-effect is inherent in crystalline dielectrics or not. Quartz plates cut parallel to their optical axis, one parallel to its electrical axis, one perpendicular to, and one obliquely to the same axis, and also rock-salt were studied. It was found that the anomalous after-effect with quartz plates cut parallel to the optical axis appears at the same limiting potential as in the case of a quartz plate cut perpendicular to its optical axis, but its magnitude is about five times smaller than that of the latter. The variation of the apparent resistivity and the recovery time are also smaller than in the case of the quartz plate cut perpendicular to the optical axis. In rock-salt the after-effect is very small and no anomalous after-effect was found. Quartz plates cut parallel to their optical axis behave in a way similar to that of plates cut perpendicular to the axis, but the magnitude of the saturated recovery time and the apparent resistivity are several times smaller than in the latter case. J. J. S.

3537. Electric Field Distribution in Dielectric Liquids. J. Dantscher. *Ann. d. Physik,* 9. 2. *pp.* 179–216, *April* 25, 1931.—The processes of current conduction in liquid dielectrics were studied by means of an optical polarisation arrangement in which the electric field distribution between plate electrodes was obtained by examining the electric double refraction (electro-optical Kerr effect) by photographic pictures. The electric double refraction was measured by a Rayleigh compensator. The liquid used was chlorbenzene and some observations were also made with toluene. The following results were obtained: (1) With alternating tension a homogeneous field was established for both liquids. (2) With direct tension there occurs in chlorbenzene a strong rise of field from the anode to the kathode. With a distance of 7 mm. between the electrodes the photographs give a ratio of the field strengths at the electrodes of

1·5 with liquid chlorbenzene. (3) The field distribution is smoothed out with time till the homogeneous field is obtained. (4) The magnitude of the field distortion and the time in which the homogeneous field is attained increases with the degree of liquidity and the distance apart of the electrodes. The times observed vary between 10 min. and several hours. (5) On account of the field distortion there arises a constant space charge in the whole electrode region as well as one occurring in front of the electrode. (6) Negative space charges were only fugitively observed. (7) No field distortion was observed in the case of toluene. (8) The observations lead to the conclusion that the change of the Kerr constant of insulating liquids, which with increasing purity was observed by some investigators, does not in general hold true; such can also be produced by changes of field. J. J. S.

3538. Surface Leakage of Pyrex Glass. W. A. Yager and S. O. Morgan. *J. Phys. Chem.* 35. *pp.* 2026–2042, *July*, 1931.—A method of measuring surface leakage of glass at various humidities is described. The nature of the leakage is discussed. The surface conductivity, surface capacity, and power factor all depend upon the thickness of the surface film, which in turn depends upon the relative humidity. The surface conductivity and power factor further depend upon the volume conductivity of the surface film. The surface quantities as well as the power factor increase with relative humidity in much the same manner as the adsorption of water vapour on glass as observed by McHaffie and Lenher. The conductance was found to increase with increasing frequency whereas the capacity and power factor decrease. The increase in power factor with relative humidity is least at high frequencies. The surface conductivity and capacity were found to depend upon frequency. Several mechanisms have been proposed to account for this dependence of which electrode polarisation is the most probable. The data for the dielectric loss and absorption in Pyrex glass were found to fit v. Schweidler's equations. The constant *n* appearing in these equations was shown to be the ratio of the phase angle of the anomalous current to 90°, the phase angle of an ideal dielectric. AUTHORS.

3539. Dielectric Constants of Hydrogen Peroxide-Ether and Hydrogen Peroxide-Water-Ether Mixtures. E. P. Linton and O. Maass. *Canad. J. of Research*, 4. *pp.* 322–329, *April*, 1931.—The dielectric constants of solutions of hydrogen peroxide and of hydrogen peroxide-water mixtures in ether have been determined over a wide range of concentrations. It was shown: (*a*) that the dielectric constant of hydrogen peroxide in ether is proportional to the amount of hydrogen peroxide per unit volume, and (*b*) that the variation of the dielectric constant with mole fraction was proportional to the dielectric constant of the solution examined, so that the logarithm of the dielectric constant varies in a linear way with the molecular fraction. By this means the dielectric constant of pure hydrogen peroxide at 0° C. was found to be 93·7. It has been shown that hydrogen peroxide-water mixture has a higher dielectric constant than either constituent. The densities of ether-hydrogen peroxide solutions were measured and a maximum aberration from the mixture rule found at a 1 : 1 concentration. AUTHORS.

3540. Dielectric Constant and Chemical Constitution. A. Chrétien. *Comptes Rendus*, 192. *pp.* 1385–1387, *June* 1, 1931.—The author describes a modification of the classical bridge method of Nernst for the measurement of the dielectric constant and gives data for benzene, chloroform, hexane and acetal. H. H. Ho.

3541. Dielectric Constant of Formic, Acetic and Propionic Acids and the Electric Moment of Complex Molecules. C. T. Zahn. *Phys. Rev.* 37. *pp.* 1516–1526, *June* 1, 1931.—The temperature and pressure variation of the dielectric constant of formic and propionic acid vapours have been studied experimentally and the behaviour found to be similar to that previously found for acetic acid [see Abstract 3510 (1930)]. For formic acid it is possible to calculate from Coolidge's vapour density measurements the amount of dissociation into double molecules, and to explain the apparent departures from Debye's theory in terms of such association. It is then seen that the apparently linear pressure curves can be explained by the compensation of several factors in the measurements. By assuming that the optical part of the polarisation is doubled on association, and taking this value from refractivity measurements, values for the electric moment of the single and double molecules of formic acid are obtained, $1 \cdot 51 \times 10^{-18}$ and $0 \cdot 99 \times 10^{-18}$ e.s.u., respectively. Values for acetic and propionic acid are similarly given as $1 \cdot 73 \times 10^{-18}$ and $1 \cdot 74 \times 10^{-18}$. The electric moment of complex molecules is discussed with reference to directed valence and to internal free rotation around single bonds, and the possibility of the importance of interaction between external and internal free rotation is suggested. The question of the interpretation of measured electric moments is raised for the case where free rotation causes a time variation of electric moment. In this connection the experimental values of electric moment are discussed, these indicating that the OH group is tightly bound. A structure for the double molecule of formic acid is suggested. H. H. Ho.

3542. Suspension Method for Determination of Dielectric Constants of Conducting Liquids. W. Graffunder and R. Weber. *Ann. d. Physik,* 9. 7. *pp.* 887–904, *June* 10, 1931.—The authors first discuss the defects of the usual suspension method, which is really only suitable for very well insulated dielectrics. Since this is in principle a substitution method, an improved process on similar lines is now described in detail, which permits measurements of great accuracy, and in which the defects of the older method are removed. H. H. Ho.

3543. Dielectric Behaviour of Methylamines. O. Steiger. *Phys. Zeits.* 32. *pp.* 425–434, *June* 1, 1931.—Records the dielectric behaviour of mono-, di-, and trimethylamine in the gaseous state, but is principally concerned with the very comprehensive description of an apparatus for the purpose. Tables of data are included and compared with those for ammonia. From stability considerations the ammonia molecule is assigned a pyramidal structure with the nitrogen atom at the apex, and, by successive replacement of an H-atom with a methyl group, an increase in polarisability accrues; which tends to spread out the pyramid with increasing liability to disturbance of its symmetry. H. H. Ho.

3544. Electric Moments and Molecular Constitution. G. Allard. *Comptes Rendus,* 192. *pp.* 1455–1457, *June* 8, 1931.—The author calculates the electric moments of a large number of organic compounds by attributing a definite electric moment not only to each group, but to each bond between the atoms, the latter partial moment being ascribed to the

direction of the bond, and making a distinction between carbons which have single and double bonds. In the calculations for benzene derivatives all the carbons are assumed to be ethylenic, and since excellent agreement is obtained between the calculated and observed values, this fact is stated to favour the tri-ethylenic character of benzene. *p*-Chlorophenol appears to be an exception although falling into line if given a quinonoid formulation.
H. H. Ho.

3545. Electrical Energy of Dipole Molecules in Solution, and the Solubilities of Ammonia, Hydrogen Chloride and Hydrogen Sulphide in Various Solvents. R. P. Bell. *Chem. Soc., J. pp.* 1371–1382, *June*, 1931.—The connection between the electrical energy of dipole fields and the solubility relations of dipole molecules is discussed. Values are given for the solubilities of HCl, H_2S and NH_3 in a number of solvents. It is concluded from the results that it is not permissible in these cases to treat the solvent as a continuous medium. More regular relations are found in previous data for the solubilities of the mercuric halides in various solvents, and a calculation on the basis of the theory here developed gives reasonable values for the dipole moments. H. H. Ho.

3546. Electric Moment and Molecular Structure. Part IV. The Glycols. C. P. Smyth and W. S. Walls. *Am. Chem. Soc., J.* 53. *pp.* 2115–2130, *June*, 1931.—In the first paper of this series [see Abstract 2382 (1931)] the effect upon the resultant electric moment of the molecule produced by separating the component moments by a carbon chain of varying length was investigated, the complex $-\mathrm{COOC_2H_5}$ group being placed at each end of the chain. In the present investigation, the simpler $-$ OH group has been attached to the carbon chain. The dielectric constants and densities of *n*-butyl alcohol and of five glycols have been measured in solution in 1 : 4 dioxane at 25° and at 50°, and the refractive indices of the substances in the pure liquid state or in solution have been determined, the data being used to calculate the electric moments of the molecules. Because of rotation around the bonds, the relative positions of the two hydroxyl groups in the molecule do not have large effects upon the moment, but the absence of any significant difference in moment between trimethylene, hexamethylene and decamethylene glycol is regarded as indicating that there is no very pronounced bending of the carbon chain. [For Part III see Abstract 2759 (1931).] H. H. Ho.

3547. Electric Moments of the Fixed Vegetable Oils. W. N. Stoops. *J. Phys. Chem.* 35. *pp.* 1704–1711, *June*, 1931.—The dielectric constants and densities of three vegetable oils, tung, linseed and castor oil, have been measured over a wide temperature range and their polarisation calculated. The electric moments of these oils and of tristearin were obtained by means of measurements on their dilute solutions in benzene and are 2·8, 3·0, 3·7 and $2{\cdot}7 \times 10^{-18}$ e.s.u. respectively. The values are discussed from the standpoint of the molecular structure of the compounds. These oils are typical of the group of fixed oils and fats of the triglyceride structure and they may all be expected to have electric moments varying from 2·7 to 3·7. H. H. Ho.

3548. Electric Moments of the Stereoisomeric Hydrobenzoins. A. Weissberger and R. Sängewald. *Zeits. f. phys. Chem.* 12. *Abt.* B. 6. *pp.* 399–407, *June*, 1931.—These electric moments have been measured at 25° and the influences of directing substituents upon the moments of meso- and racemic forms discussed. It is shown that for the determination of dipole moments, measurements in supersaturated solutions may be employed. In this way the moments of *d*-dimethyl tartrate and dimethyl racemic acid have been determined. [See also Abstract 4074 (1930).] H. H. Ho.

3549. Electrical Conductivity of the Air at Paris. (Mme) F. Bayard-Duclaux. *Comptes Rendus*, 192. *pp*. 810–812, *March* 30, 1931.—An investigation of leakage through the insulators was made as a preliminary to measurements of the conductivity of the air. Amongst the chief results of observations on the conductivity are the following: (1) A very accentuated minimum occurs in January, prolonged into February and March. It is preceded by a rapid decrease in autumn and followed by a quick increase in spring. This same behaviour is found at Val-Joyeux and at Kew. It corresponds to a course inverse to that of the atmospheric-electric field. (2) In the afternoon a rapid decrease of the conductivity occurs. (3) On comparing the values of the conductivity at Paris and at Val-Joyeux the ratio was found to lie between 0·20 and 0·30, and corresponds with the ratio between the small positive ions and the small negative ions respectively at Paris and Val-Joyeux. This ratio is 0·25, which agrees with theory. (4) When the wind is from the east there is a very marked maximum for the ratio of the conductivities. (5) Increase of relative humidity as it tends towards the formation of large ions causes a diminution of the conductivity. J. J. S.

3550. Formulæ of Biot-Mollweide and of Pinto Compared with the Values of the Magnetic Elements in Somaliland. D. di Filippo. *Accad. Lincei, Atti*, 13. *pp*. 186–190, *Feb* 1, 1931.—To explain the magnetic action of the earth Biot, developing an idea of Euler, imagined two symmetrically-arranged magnetic masses of opposite sign placed at the centre of the earth and at a small distance apart, so as to form a magnet of very small length but very powerful. This working hypothesis was used by Biot to deduce some relations between the magnetic latitude, the magnetic inclination and the total magnetic force. Later Mollweide gave a modified formula which was more simple and Pinto gave one which claimed to be more exact. The author of this paper has compared the values of the magnetic quantities calculated from these formulæ with the observations experimentally made in Italian Somaliland and gives tables illustrating the comparison. These show that the Biot-Mollweide formula gives better results when compared with experiment in low magnetic latitudes, and that Pinto's formula does not show itself to be advantageous. J. J. S.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

3551. Conductivity Measurements with Deformed and Tempered Rock-Salt Crystals. F. Quittner. *Zeits. f. Physik*, 68. 11, 12. *pp*. 796–802, *April* 20, 1931.—The true conductivity as well as the permanent conductivity of rock-salt crystals is changed by tempering and deformation. The van't Hoff formula for the temperature dependence of the true and permanent conductivity is satisfied also by the deformed and tempered crystals. The constants of this formula decrease with increasing tempering, and increase considerably through small deformation at lower temperatures. [See also Abstract 2933 (1929).] H. M. B.

3552. Detection of Added Water in Milk and Other Substances. B. Davies. *Journ. Sci. Instruments*, 8. *pp*. 160–164, *May*, 1931.—A simple resistance method is described whereby normal and adulterated milk can be compared, this consisting of a double-cell system for the purpose of balancing out any small differences in capacitance and eliminating small variations of temperature. Full details are given with the relevant mathematical treatment. H. H. Ho.

3553. Mechanism of Copper-Oxide Rectification. W. Leo. *Ann. d. Physik*, 9. 3. *pp.* 347–365, *May* 2, 1931.—According to Fleischmann [see Abstract 3545 (1930)], films of copper oxide or silver sulphide have the faculty of retaining electrons like a condenser of great capacity but poor insulation. The author examines the surface potentials of copper oxide in a high vacuum with a previous electron charge. Both cupric and cuprous oxide, especially the latter, retain electrons after a bombardment for hours with electrons from an incandescent wire. There is evidence of the formation of a blocking layer as in copper-oxide rectifiers. The capacity is of the order of $0 \cdot 005\,\mu F/cm.^2$, which suggests molecular dimensions. E. E. F. d'A.

3554. Action of Current Rectifiers. W. C. van Geel. *Zeits. f. Physik*, 69. 11–12. *pp.* 765–785, *June* 13, 1931.—Current-voltage curves have been measured and analysed for different dry and electrolytic rectifiers. Both in the positive and negative direction (*Fluss und Sperrichtung*) these curves can be represented by the equations $i = AF^2e^{-B/F}$ and $i = CF^{3/2}$. A, B and C are constants of the materials employed on either side of the thin layer of dielectric or electrolyte, i is the current and F the field intensity at the emitting surface. It appears that the currents are emission currents (cold electronic emission). The fields occurring in rectifiers, the active surfaces and the relation between the forward and retrograde currents are calculated approximately. It is shown that not only the exit work (Richardson's ϕ), but also the inner exit work (Sommerfeld's W_i) are of importance in the problem. H. N. A.

3555. Relationship of the A.C. Resistance of an Iron Wire to Mechanical Strain. B. Ssadikov. *Arch. f. Elektrot.* 25. *pp.* 431–435, *June* 19, 1931.—It is shown that for a wire of thickness 0·1 mm. the resistance can be disturbed to the extent of as much as 10 % by mechanical strain using for test a wave-length of 100 m. Again, further experiments with a frequency of the order 1000 and a wire 1 mm. thick, the disturbance lies between 10 and 15 %. Taking wires of 1 to 6 mm. thickness and a frequency of 50 ∼, it is shown in the present work that not only longitudinal stress but also bending will greatly influence the a.c. resistance, the disturbance amounting to as much as 30 % from this cause. The effect of bending the wire into a ring is thus discussed. Questions of external pressure on the outer surface of the wire are investigated and shown to have a directly measureable effect. The suggested cause of the influence of mechanical strains on the resistance to a.c. is that the mechanical tension has an influence on the circular magnetic permeability of the iron, upon which the a.c. resistance of the iron wire depends. S. G. B.

3556. Change of Resistance in Strong Magnetic Fields. P. Kapitza. *Zeits. f. Physik.* 69. 5–6. *pp.* 421–423, *May* 12, 1931.—A reply to Stierstadt, who has criticised [see Abstract 2396 (1931)] the author's results [see Abstract 2580 (1929)] in respect of the effect due to a magnetising current in a wire wound on a cylinder being to some extent transversal as well as longitudinal. Stierstadt is considered to have overestimated the importance of this effect. G. E. A.

3557. Theory of the Change of Resistance in Magnetic Fields. R. Peierls. *Ann. d. Physik,* 10. 1. *pp.* 97–110, *June* 24, 1931.—A theoretical review and discussion of present knowledge. At high temperature the change of resistance in small fields is given by the equation $R = R_0[1 + \alpha(H/4\pi necR_0)^2]$ where α is a numerical factor, dependent on the direction of magnetisation, and independent of the temperature, and R_0 is the specific resistance without a magnetic field. So long as this expression is small this law is valid. In strong fields the resistance approximates to a limiting value, which seems to differ from the value for $H = O$ according to a numerical quantity independent of the temperature. For low temperatures, neglecting the remanent resistance, two critical field strengths are found, of which one is $H_1 = 4\pi nec$, and the other is twice as great as the first and for low temperatures is related to the cube of the temperature. The consequences of this formula and reasoning are fully discussed. S. G. B.

3558. Statistical Theory of Thermoelectric, Galvano- and Thermomagnetic Phenomena in Metals. A. Sommerfeld and N. H. Frank. *Rev. Modern Physics,* 3. *pp.* 1–42, *Jan.,* 1931.—This paper gives a somewhat detailed account of the new electron theory (as developed by Lorentz and reinforced by the application of the Fermi–Dirac statistics) in so far as the theory applies to the subjects mentioned in the title. (A) With regard to thermoelectricity the effects in homogeneous metallic circuits are considered, and attention is given to the Thomson effect in its various aspects, while such effects, *e.g.,* Peltier effect, as appear only in circuits where two or more metals are present, are not dealt with. This section commences with a short review of H. A. Lorentz's method for handling the problem of electrical and thermal conduction in metals. (B) The magnetic effect in metals is dealt with under the following divisions: (1) the general principles relating to a conductor in a homogeneous magnetic field, the discussion being confined to the action of this field on the free electrons in the metal, as far as is necessary for the understanding of the galvano- and thermomagnetic phenomena; (2) conduction in a homogeneous magnetic field, in which the determination of the various thermo- and galvanomagnetic effects is obtained by an extension of the method of part A; (3) isothermal effects, dealing with the Hall effect, the conductivity in a magnetic field and the Nernst effect; (4) adiabatic effects, treating of the two transversal galvanomagnetic effects, the Ettingshausen effect, and the Leduc–Righi effect; (5) the change of resistance of a metal in a magnetic field, giving a more or less detailed discussion of the different effects; (6) the two galvanomagnetic effects, the Hall and the Ettingshausen effects, are examined in more detail; (7) the thermomagnetic effects, comprising the Nernst and Righi–Leduc effects, are discussed; (8) the relations among the transverse effects are theoretically established on the basis of the foregoing values for the various effects; and (9) wave-mechanical refinements. While the results of the theoretical considerations are on the whole satisfactory and relatively simple, there are weaknesses therein which are discussed in section (9). The removal of these weaknesses can be accomplished by a more rigorous wave-mechanical calculation, but this, to be quite satisfactory, requires a more thorough knowledge of the interatomic fields than is at present available. In most cases the results of the wave-mechanical calculations of conductivity are so complicated and contain so many unknown quantities that quantitative discussion is not possible. J. J. S.

3559. Thomson Effect in Single Crystals of Zinc and Cadmium. H. Verleger. *Ann. d. Physik*, 9. 3. *pp*. 366–384, *May* 2, 1931.—Single crystals of 50 cm. length and about 3 mm. dia. were prepared by Bridgeman's method. The orientation of the principal axis was found by measuring the specific resistance. The Thomson effect was measured by Cermak's method, and was calculated for the directions parallel and perpendicular to the main axis by Voigt's formula. For cadmium, the Thomson effect was found to be $19 \cdot 55 \times 10^{-7}$ gm. cal. at 100° C., perpendicular to the axis and $16 \cdot 40 \times 10^{-7}$ gm. cal. parallel to the axis.
E. E. F. d'A.

3560. Thermocouples Whose Elements are Longitudinally and Transversely Magnetised Wires of Nickel and of Iron. W. H. Ross. *Phys. Rev.* 38. *pp*. 179–181, *July* 1, 1931.—It has been shown that a thermal e.m.f. may be established between magnetised and unmagnetised elements of any ferromagnetic substance. In this paper the thermal e.m.f.s. developed between longitudinally and transversely magnetised elements of the same ferromagnetic substance are quantitatively studied. Nickel and iron, both in the annealed and unannealed conditions, have been investigated. AUTHOR.

3561. Thermoelectric Batteries. J. Chappuis and A. Gouffé. *R.G.E.* 29. *pp*. 615–628, *April* 18, 1931.—Optimum conditions are studied for the use of thermoelectric batteries when applied to the measurement of the intensity of radiation, taking the temperature of a black body as the standard as in the method due to Lummer and Kurlbaum. The paper is divided into two parts: (1) In the first an account is given of the experimental results obtained when the pressure of the air is changed in the cavity in which the thermoelectric couple is placed. These results show in a general way that a considerable reduction of this pressure increases the sensitiveness of the thermoelectric battery, at least between two definite limiting values of the pressure. The authors describe the experiments made to explain the existence of a lower limit beneath which the sensitiveness varies no longer. As regards the proportionality of the e.m.f. to the intensity of radiation, it is realised to a close approximation both in air and *in vacuo*. (2) The second part of the paper is a theoretical study of thermoelectric batteries with one, or several, elements. The object of this theoretical investigation is to make manifest on the basis of thermodynamics the improvement of the sensitiveness which results from the reduction of the pressure. The influence on the sensibility of the geometrical dimensions, of the physical properties and of the number of elements, is considered; and taking into account the inertia of the battery the time taken to get it into order (*i.e.*, to put it in equilibrium of temperature, or in permanent *régime*) is determined. In conclusion, it is pointed out that all the characteristics of a thermoelectric battery can be determined *a priori* by calculation; but in order that the numbers obtained in the numerical applications may have a precise and sure value it would be necessary to know in a much more certain way the value of the coefficient of external losses. In particular the factor of radiation and the coefficient of convection are badly determined. J. J. S.

3562. Back E.M.F. in Mercury Arcs. H. v. Dzlewulski. *Zeits. f. Physik*, 69. 5–6. *pp*. 366–372, *May* 12, 1931.—The back e.m.f. in a mercury arc is measured by an alteration of a method originally devised by Duddell, and including improvements suggested by Hagenbach and Wehrli, and its dependence upon vapour pressure and current is ascertained. When no distillation of mercury takes place at the electrodes a stable state of the arc exists in which the value of the back e.m.f. is approximately zero. With slight distillation a quasi-stable state is set up, when the back e.m.f. increases with increasing vapour pressure, the current being kept constant. It decreases even to negative values, as the current increases at constant vapour pressure. It is concluded that the chief and probably the only origin of the back e.m.f. is a positive space charge near the kathode, and a negative space charge near the anode. N. D.

3563. Pressure on the Kathode of an Arc Light. R. Risch. *Helv. Phys. Acta*, 4. 2. *pp.* 122–128, 1931.—The results obtained by Tanberg and Kobel [see Abstract 1642 (1931)] in their investigation of the velocity of the vapour which streams away from the Cu or Hg Kathode of an arc light burning *in vacuo* are discussed. The velocities found express as to Cu vapour a temperature of 500,000° K. and as to Hg a temperature of about 9,000,000° K. On the assumption of singly-charged atoms the velocities correspond to 80 and 1000 volts. The conclusion is reached, however, that the whole question is not yet thoroughly explained. J. J. S.

3564. Temperature Measurements of the Tungsten-Nitrogen Arc. E. Sieboth. *Helv. Phys. Acta*, 4. 3–4. *pp.* 153–188, 1931. *In German.*—The temperature of the electrodes of a tungsten-nitrogen arc has been measured over the pressure range of 16–500 mm. and with currents varying from 0·1–1·0 ampere. F. J. W.

3565. Kathode Temperature in a Vacuum Arc. R. Tanberg and W. E. Berkey. *Phys. Rev.* 38. *pp.* 296–304, *July* 15, 1931.—Pyrometric and spectroscopic tests show that the metal kathode spot in a vacuum arc is not at an extremely high temperature. The temperature of a copper kathode is measured by an optical pyrometer and found to be about 3000° K. in a 20-ampere arc. Spectroscopic examination of the kathode spot shows only a faint continuous spectrum indicating that the temperature of the kathode is not high. A temperature of the above magnitude is shown to be sufficient to give the rate of vaporisation required to account for observed loss of kathode material under extreme assumptions. The results show that the high speed of the vapour stream issuing from the kathode region cannot be due to high temperature of the kathode itself. AUTHORS.

3566. Effect of Surface Films on Exploring Electrodes in Gas Discharges. W. E. K. Middleton and T. Alty. *Canad. J. of Research*, 4. *pp.* 498–504, *May*, 1931.—The presence of organic vapours in a hydrogen discharge is shown to influence greatly the current collected by an exploring electrode immersed in the discharge. It appears that the vapour molecules striking the collector may remain attached to its surface, thus forming an insulating layer around it and limiting the current collected. The rate of formation of this layer is obtained from the rate of decrease of current to the collector. It is shown that this rate varies very greatly with the voltage of the collector and that the time required for the current to be reduced to one-half its initial value is shortest when the collector is at the space potential. AUTHORS.

3567. Form of the Positive Column Set up by Short Periodic Activation. O. Bartelt. *Ann. d. Physik*, 9. 6. *pp.* 679–703, *May* 28, 1931.—The positive column set up in a cylindrical discharge tube by short periodic impulses of direct p.d. may be of two types. In one the column forms a glowing cylindrical ring coaxial with the discharge tube, with a central dark space; in the second, the centre of the discharge tube is filled with a glowing column which is separated from the above cylindrical ring by a dark space. The rare gases under suitable conditions give both types of column whilst the others give only the first. These conditions are described. F. J. W.

3568. 500-kV Kathode Rays. R. E. Vollrath. *Phys. Rev.* 38. *pp.* 212–216, *July* 15, 1931.—The high potential X-ray tube at the California Institute has been modified so as to permit either X-rays or kathode rays to be produced. Electron currents up to 35 microamperes have been obtained through an aluminium window. A typical magnetic velocity spectrum of the high-speed electrons passing out of an aluminium window is presented. The high-velocity limit corresponds to about 500 kV when the transformer voltage is 600 kV peak. The velocity spectrum appears to be continuous and no absorption anomalies due to aluminium and lead foil are evident. The time required to obtain a velocity spectrum was reduced to a few minutes by allowing the electrons after being magnetically deflected to pass through a copper foil into the air. The outside of the foil is coated with calcium tungstate and the photographic plate is placed in contact with the tungstate. It is noted that part of the photographic action of the high-speed electrons is due to fluorescence of the glass backing of the photographic plates. AUTHOR.

3569. Change in Charge of Canal Rays in Hydrogen. J. Koenigsberger. *Zeits. f. Physik*, 69. 5–6. *pp.* 424–427, *May* 12, 1931.—In connection with the discordant results obtained for the above, the author discusses certain experimental details in his own and other investigations and the possible sources of error which may be the cause of these discrepancies. G. E. A.

3570. Charging Process at the Surfaces of Dielectrics Bombarded by Electrons or Positive Particles. S. Kalaschnikoff. *Zeits. f. Physik*, 69. 5–6. *pp.* 380–388, *May* 12, 1931.—Plates of quartz and of mica were bombarded *in vacuo* with slow electrons and with positive particles, the initial energy of which varied from 5 to 160 volts. The relation between the potentials produced on the surfaces of the plates and the energy of the colliding electrons or ions was investigated. For the positive bombardment the limiting potential increases almost linearly with the initial energy of the particles. With electrons there is a sudden diminution of the limiting potential when a definite critical electronic energy is reached. This critical value is found to be 30 ± 1·5 volts for quartz and 29 ± 2 volts for mica. The result for electrons is difficult to explain, but it appears to be connected with the production of secondary electrons in the air contained in the discharge tube. H. N. A.

3571. Ions in a Cylindrical Field. M. Pauthenier and (Mme) M. Moreau-Hanot. *Comptes Rendus*, 192. *pp.* 1086–1087, *May* 4, 1931.—Under normal temperature and pressure the corona effect may be sufficiently intense to secure that the passage of ions takes the minimum time.

Certain observations of an enhanced or reduced mobility of ions are attributable to experimental errors. [See Abstract 1575 (1930).]
E. E. F. d'A.

3572. Accommodation Coefficients of Positive Ions of Argon, Neon and Helium. C. C. van Voorhis and K. T. Compton. *Phys. Rev.* 37. *pp.* 1596–1610, *June* 15, 1931.—Positive ions of argon, neon and helium produced in a low voltage arc were attracted to a spherical metal collector by regulated potentials up to 140 volts. The resulting heating of the collector was measured by a thermal junction and found to be *considerably less* than the product of the current by the attracting voltage. After taking account of the energy scattering at collisions and of the effect of the secondary electron emission, the following values of the "accommodation coefficients" were obtained: argon $0{\cdot}75 \pm 0{\cdot}05$, neon $0{\cdot}65 \pm 0{\cdot}05$ (both between 21 and 141 volts), and helium $0{\cdot}35 \pm 0{\cdot}05$ between 21 and 51 volts and $0{\cdot}55 \pm 0{\cdot}05$ between 111 and 141 volts.
AUTHORS.

3573. Theoretical Effective Cross-Sections of Molecules. H. E. Binkele. *Ann. d. Physik*, 9. 7. *pp.* 839–852, *June* 10, 1931.—The influence of the temperature-function of viscosity on the calculation of the constant $M\Theta^x$ is discussed: here $M\Theta$ is the "molar characteristic temperature," and x has different values for different gases (5/6 for H_2 and He, 9/10 for Ne). The expression $M\Theta^x$ contains a constant ϕ that depends on the gas and the reciprocal of the cross-section of the gas-molecule. It is shown that the temperature-function of the second virial coefficient of van der Waals' equation is to be treated analogously to the temperature-function of viscosity in the case of the light gases. The constants calculated from viscosity agree well with the values of b in van der Waals' equation. These theoretical values agree better with those obtained by Ramsauer than values that were obtained earlier.
H. L. B.

3574. Magnetic Spectrographs with Slow Electrons. G. Bernardini. *Accad. Lincei, Atti*, 13. *pp.* 361–364, *March* 1, 1931.—A note on certain practical technical difficulties encountered by the author in the management of these instruments.
A. D.

3575. Quantum Losses of Velocity of Slow Electrons in Nitrogen. H. Löhner. *Ann. d. Physik*, 9. 8. *pp.* 1004–1016, *June* 17, 1931.—In a previous paper [see Abstract 244 (1931)] the author had used Lenard's method to investigate the critical potentials and the output (*Stossausbeute*) for the gases H_2, N_2, CO_2 and A. In the present experiments the apparatus has been modified in five different ways to increase the sensitivity of the method. The following hitherto unknown critical potentials in the case of N_2 were observed: $2{\cdot}45$ volts, $3{\cdot}1$ volts, $3{\cdot}6$ volts, $4{\cdot}15$ volts, the order of accuracy being $\pm\, 0{\cdot}1$ volts. These results are derived from 27 curves obtained with the five different kinds of apparatus.
H. L. B.

3576. Transmission of Electrons Through Potential Barriers. N. H. Frank and L. A. Young. *Phys. Rev.* 38. *pp.* 80–86, *July* 1, 1931.—It is shown that the application of the Wentzel-Kramers-Brillouin approximate solution of the wave equation to problems of the transmission of electrons through potential barriers leads to simple derivations of formulæ for ths transmission coefficient. This method may be applied systematically to potential barriers of arbitrary form.
AUTHORS.

3577. Cycles and Creeping in Photoelectric Cells with Gaseous Atmospheres. G. A. Boutry. *Comptes Rendus*, 192. *pp.* 831–834, *April* 7, 1931.—Extends previous work on the characteristic curves of photoelectric cells, in which the values of the luminous flux and p.d. were brought back to zero between every two readings [see Abstract 2792 (1931)]. The characteristics are now obtained with continuously varying flux and current at constant p.d. As the flux is increased the current also rises, the initial slope being greater the greater the p.d. After various changes the regions 4 and 5 mentioned in the earlier papers are reached. If now the flux is diminished the current falls slightly, but does not fall to zero with the flux. The current-flux curve forms a cycle whose area is reduced if described several times in succession. If, after strong illumination, the light is cut off suddenly, the current takes several seconds to fall to zero. This seems to be due to residual ionisation of the gas in the cell. If the flux and p.d. are kept constant at certain values, the current, instead of remaining constant, creeps up slowly and irregularly for a period which may reach 30 min. This increase in emission is due to the bombardment of the kathode by numerous fast positive ions. Increases of current up to 200 % have been found in the Dunoyer type of cell, and in all those in which there is a thick layer of potassium. In the Déjardin thin-layer type the average increase is 2·5 % for currents of 100 mA. N. D.

3578. Photoelectric Effect from Coated Platinum Filament. K. Newbury and Frances Lemery. *J.O.S.A.* 21. *pp.* 276–281, *May*, 1931.—The photoelectric effect is studied from a platinum filament coated with barium oxide. It was found that (1) The photoelectric current increases with plate potential. No maximum was reached, the current approaching a saturation value at approximately 13 volts. (2) The photoelectric current for a constant voltage (sufficiently high for the current to be near its saturation value) increased with filament temperature until about 1000° C., and then rapidly decreased. (3) The long wave-length limit of the effect is not higher than 4046 Å. A. C. M.

3579. External Photoelectric Effect in Phosphors and its Dependence on the State of Excitation. H. Göthel. *Ann. d. Physik*, 9. 7. *pp.* 865–886, *June* 16, 1931.—Using very thin films it is found that, (*a*) the photoelectric current reaches saturation with increasing p.d.; (*b*) the fatigue of the photoelectric effect is not apparent with very thin films, and is attributed, with thick layers, to the bad conductivity of the phosphor; (*c*) the external photoelectric effect is proportional to the light intensity. The agreement between the excitation maximum for photoelectric effect and phosphorescence found by Göggel is confirmed. Under excitation the long-wave limit of photoelectric excitation retreats towards the red, but under the effect of the extinguishing radiation this retreat is again reversed. J. E.

3580. Geiger-Müller Ion Counter and Space Distribution of X-Ray Photoelectrons. J. A. van den Akker and E. C. Watson. *Phys. Rev.* 37. *pp.* 1631–1638, *June* 15, 1931.—The photographic plate in the apparatus for the magnetic analysis of X-ray photoelectrons has been replaced by a Geiger-Müller ion counter and the magnetic spectrum of the photoelectrons ejected from a thin film of gold by primary X-rays from molybdenum has been studied. Very great resolving power is obtained, and considerable precision in determining the exact position of the lines (*i.e.* the energies of the photoelectrons). The number of L_{III} electrons of gold ejected by the $K\alpha_1$ X-rays of molybdenum have been plotted as a function of the angle of ejection and compared with the theoretical longitudinal distribution predicted by Schur. AUTHORS.

3581. Relativistic Theory of the Photoelectric Effect. Part I. K-Absorption of X-Rays. H. Hall. Part II. Photoelectric Absorption of Ultra-γ Radiation. H. Hall and J. R. Oppenheimer. *Phys. Rev.* 38. *pp.* 57–79, *July* 1, 1931.—*Part I.*—A strict theory of the absorption of X-rays is developed on the basis of relativistic quantum electrodynamics. The theory is applied to the absorption of X-rays by a Dirac electron in the field of a nucleus. Corrections to the non-relativistic theory are appreciable only for heavy elements, where the present calculations give a K-discontinuity 20 % smaller than the earlier ones. The agreement with experiment is not improved. *Part II.*—The theory is applied to the calculation of the absorption of quanta whose energy is larger than the proper energy mc^2 of the electron. The cross-section for absorption is here given approximately by $\sigma \sim 2 \times 10^{-22} Z^5 \lambda$. This result is applied to account for the excess absorption over that predicted by the Klein-Nishina formula found experimentally for the γ-rays of ThC″ by Chao and Tarrant. The theory is in fairly good agreement with experiment for Cu, but disagrees violently with it for Pb. An examination of the approximations made in deriving and applying the theoretical result shows that they cannot have introduced this discrepancy. There is thus a definite conflict between electrodynamical theory and experiment. AUTHORS.

3582. Theory of the Photoelectric Effect. J. Frenkel. *Phys. Rev.* 38. *pp.* 309–320, *July* 15, 1931.—It is shown that the theory of photoelectric effect in a H-like atom can be successfully developed on the basis of the representation of the ejected electrons by means of plane waves, the results being exact with regard to angular distribution of the ejected electrons and satisfactory with regard to the dependence of the ejection probability on the frequency of the light. The theory is extended to take account of the mobility of the nucleus. The Tam-Schubin theory of the selective photoelectric action in metals is critically examined and replaced by an improvement of Fowler's theory, in connection with a discussion of the selective transparency of surface electric fields to electrons. AUTHOR.

3583. Photoelectric Properties of Thin Unbacked Gold Films. R. P. Winch. *Phys. Rev.* 38. *pp.* 321–324, *July* 15, 1931.—Unbacked films of gold 2×10^{-6} cm. thick were produced and studied to determine their photoelectric behaviour. These films did not hold a constant photoemission, but showed a rapid increase in emission with exposure to ultraviolet light. The increase in photoelectric current was 136-fold, and was accompanied by a shift in long-wave limit of 576 Å. Solid gold and silver were given similar treatment and showed a like effect. This increase is explained on the basis of outgassing caused by ejected electrons removing gas from the surface. The final long-wave limit reached by the gold films is compared with that for the mass metal when outgassed by severe heat treatment. AUTHOR.

3584. Photoelectric Sensitivity Curves for Clean Metals at Various Temperatures. R. H. Fowler. *Phys. Rev.* 38. *pp.* 45–56, *July* 1, 1931.—An elementary theory is developed for the effect of temperature on the photoelectric sensitivity of a clean metal near the threshold. It is shown that the results observed by various workers for silver, gold, tantalum, tin, and potassium can be fairly completely accounted for by the effect of the temperature on the number of electrons available for extraction according to the distribution law of Sommerfeld's theory of metals. This is in agreement with the conclusions of Lawrence and Linford based on much less extensive data. A graphical method is given enabling the whole of the observed curves near the threshold for all temperatures to be used in determining the threshold itself, thus avoiding an arbitrary extrapolation to zero current. At present the fundamental theory of the effect survives in two forms, both of which are used as alternatives here, with nearly equal success. Until one or the other can be eliminated it is not possible to determine thresholds closer than about 1 %. AUTHOR.

3585. H.F. Behaviour of a Plasma. L. Tonks. *Phys. Rev.* 37. *pp.* 1458–1483, *June* 1, 1931.—An analogue for a uniformly-ionised gas is found in a shunt-tuned circuit. The formula for the specific inductive capacity K_p is extended to two simple cases of non-uniform ionisation. Formulæ are derived for calculating the conductivity and specific inductive capacity of a cylindrical plasma (positive column of an arc), using a modification of Mossotti's theory. The natural frequency of such a condenser occurs nearly when $K_p = -1$. For a fixed frequency the reactance of such a composite condenser is followed for varying arc current by observing the length of the Lecher system connected to the condenser plates which is required to cause circuit resonance. Two, and sometimes three, resonances are found. They are verified theoretically. With more detailed analysis, calculation of relative electron density is possible, and the resistance to the electron motion is found to vary considerably; the maximum amplitude of electron motion, $2 \cdot 1 \times 10^{-3}$ cm., is near the point of resonance. A transverse magnetic field, as shown by H. Gutton, doubles the resonance. The separation of resonances accords with theory. H. M. B.

3586. Oscillating Arc: Elements of Group VI. E. Z. Stowell. *Phys. Rev.* 37. *pp.* 1452–1457, *June* 1, 1931.—A study of the behaviour of S, Se, Te, Cr, Mo, W and U as kathodes in an arc in hydrogen reveals that all of them permit radio-frequency oscillations to occur in a tuned circuit across the arc. No magnetic field is required for these oscillations. The elements of the sulphur group give unsteady oscillations, disintegrate rapidly and form hydrides with the arc atmosphere. The other elements yield steadier oscillations with no chemical action, and allow the arc to operate at a high temperature. The character of the spectra of these arcs in both the oscillating and the non-oscillating states is described and comparisons made. A mechanism is suggested whereby some elements will permit oscillations to occur and some will not. AUTHOR.

3587. Oscillations of Quartz Plates. A. Lissütin. *Żeits. f. Physik*, 69. 11–12. *pp.* 850–852, *June* 13, 1931.—In a previous paper [see Abstract 2293 (1930)] the vibrations of rectangular quartz plates in two directions were investigated. Solutions of the differential equations of the vibrations of non-rectangular plates are now obtained, and the effect of the boundary conditions is discussed. N. D.

3588. Generation of Current Pulses of Rectangular Wave-Form. A. J. Maddock. *Phys. Soc., Proc.* 43. *pp.* 371–382, *July*, 1931.—A circuit for the production of single current-pulses or for use as a heavy-duty time switch is described in which there is practically no limit to current-carrying capacity. Such pulses of current can be obtained when desired by the simple depression of a key. It is shown that two distinct wave-shapes are available in different branches of the circuit and that by suitable choice of inductance, resistance and capacity the current time wave in one branch should be of rectangular form. Two separate timing-circuits are described, one for periods up to about 2×10^{-2} sec. and the other for use up to 16 sec. or longer. Suggested uses and extensions of the circuit are given. AUTHOR.

3589. Group Theory and the Electric Circuit. N. Howitt. *Phys. Rev.* 37. *pp.* 1583–1595, *June* 15, 1931.—Electrical networks consisting of inductances, resistances and capacitances form a group with the impedance function as an absolute invariant. That is, to a given impedance function there corresponds an infinite number of networks, any one of which can be obtained from any other by a special linear transformation of the instantaneous mesh currents and charges of the network. In this manner one may arrive at the complete infinite set of networks equivalent to a given network of any number of meshes. This is done by writing down the three fundamental quadratic forms of the network. Then a linear affine transformation of the instantaneous mesh currents and charges of the network results in the formation of new quadratic forms, the matrices of the coefficients of which represent a member of the group, *i.e.* an equivalent network. Instead of performing the substitutions, the three matrix multiplications $C'AC$ are used, one for each quadratic form, where A represents the original matrix, C the transformation matrix and C' its conjugate. It may be possible to extend this theory to include continuous systems where the quadratic forms become integrals or infinite series and one deals with infinite matrices and infinite transformations. AUTHOR.

3590. Theory of Magnetic Layers. M. Manarini. *Accad. Lincei, Atti,* 13. *pp.* 190–194, *Feb.* 1, 1931.—A demonstration is given of Beltrami's theorem of the equality of polar distribution of magnetism upon a surface for an apolar distribution, sum of a superficial distribution and of one along the contour, using the theory of superficial operators of Burgatti. Thus there is obtained an expression of the theorem quite analogous to that of Poisson's theorem for a polar distribution of magnetism within a space. Then the theory of magnetic layers is completed, still employing superficial operators, obtaining theorems analogous to those of Kelvin for the free magnetism of a polar distribution in space. The following propositions are stated: For any magnetic layer (1) the total mass of free magnetism (tangential) is zero; (2) the quantity of free tangential magnetism along an open surface (σ) is equal to the tangential flux entering from the curve of the contour (s), of the magnetisation h. If the surface (σ) is closed the total quantity of free tangential magnetism is always zero; and (3) the quantity of free tangential magnetism along a closed contour traced upon (σ) is equal to the tangential flux issuing from the contour of the magnetisation h. J. J. S.

3591. Connection between Ferromagnetism and Conductivity. K. Ghosh. *Zeits. f. Physik,* 68. 7–8. *pp.* 566–572, *April* 7, 1931.—It is shown that artificially produced magnetite (Fe_3O_4) under suitable conditions can be changed into a ferromagnetic modification of hematite (Fe_2O_3) which can again pass over into the usual paramagnetic form. An investigation of the relation between magnetic condition and electric conductivity in the various transformations of the Fe_3O_4 leads to the conclusion that in this ferromagnetic body the conducting electrons can be divided into two classes, of which those belonging to the first are exclusively conductors of electricity, whilst the others at the same time serve as carriers of the ferromagnetic effect. J. J. S.

3592. Transition of Ferromagnetic into Paramagnetic Manganese Arsenides. A. Smits, H. Gerding and F. Vermast. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 357–368, 1931.—The transition from the ferromagnetic to the paramagnetic condition of manganese arsenides is studied dilatometrically, both with and without the influence of external magnetic fields, in order to determine the degree of continuity and also of reversibility of the phenomenon. It is found that the usual hysteresis path is subdued, and an examination of the V/T curves for the material, at temperatures between 15° and 50° C., reveals that the paths of magnetisation intensity and specific heat with temperature are identical. The transition from one magnetic form to the other is dependent on a series of equilibrium conditions of a non-internal character, so that the Curie temperature cannot be suggested. With strong magnetic fields the volume is unaltered. In the cases where the hysteresis phenomena are preserved, and above all where the internal equilibrium conditions can be fully realised, the V/T curves take the usual form. S. G. B.

3593. Magnetic and Electric Moments of the Dirac Electron. T. Tanaka. *Zeits. f. Physik,* 69. 11–12. *pp.* 810–821, *June* 13, 1931.—Develops a formula which is suitable for relativistic consideration of the problem, and represents the magnetic moment of the electron as a three-dimensional axial vector; at the same time the electric moment of the electron, which depends on the Gordon polarisation current, is given as a three-dimensional polar vector. The action of the external field on these two moments is also investigated. H. N. A.

3594. Magnetic Moment of Nickel Ion in Chloride Solutions. G. Foëx and B. Kessler. *Comptes Rendus,* 192. *pp.* 1638–1640, *June* 22, 1931.—Four different solutions of chloride of nickel gave a magnetic moment for Ni'' of 17 Weiss magnetons; one solution was in methyl alcohol, the others in water. The expected result was 16. Solutions were then heated to different temperatures while in the magnetic field, and one heated up to 90° C. still gave 17, while one heated to 100° C. gave 16·87 magnetons. A solution heated to 100° C. and measured some months later gave 16·63, while yet another heated to 120° C. and measured some months later gave 16·02. The Curie point behaves similarly; for the last solution, as was expected, it was near to the absolute zero. A. C. M.

3595. Magnetic Moment of the Diatomic Sulphur Molecule. E. J. Shaw and T. E. Phipps. *Phys. Rev.* 38. *pp.* 174–178, *July* 1, 1931.—The magnetic properties of the diatomic sulphur molecule have been investigated by means of the Stern-Gerlach molecular-ray method. The diatomic sulphur was prepared by heating sulphur vapour at a pressure of 0·3 mm. of mercury to temperatures of 300–450° C. At the higher temperature, the magnetic fields attainable were insufficient to break down

the coupling between the rotational axis of the molecule and the spin axis of the electrons and only broadening of the image resulted. At 300° C. the image was split into two lines, one at the position of the line obtained in the absence of a magnetic field and the other on the side of the stronger field. The results prove that the diatomic sulphur molecule possesses a magnetic moment due to electron spin; the indicated configuration is a $^3\Sigma$.
AUTHORS.

3596. Magnetic Moment of the Palladium Atom. A. N. Guthrie and M. J. Copley. *Phys. Rev.* 38. *pp.* 360–364, *July* 15, 1931.—The magnetic moment of the palladium atom has been investigated by the Stern-Gerlach method by evaporating the metal from a tungsten boat resistance furnace through beam-forming slits of Pyrex glass and allowing the beam to impinge and condense on a glass plate after passing through an inhomogeneous magnetic field. It was found that images too weak to be detected could be developed satisfactorily by the method used by Stern and Gerlach for silver images. No splitting of the beam of palladium atoms was observed although the same field gave a splitting of 0·04 cm. for a beam of atomic hydrogen. This indicates that the palladium atom in its normal state has zero magnetic moment in agreement with spectroscopic results giving for its ground term a ^1S.
AUTHORS.

3597. Shape of the Magnetisation Curve in Strong Fields. N. S. Akulov. *Zeits. f. Physik*, 69. 11–12. *pp.* 822–831, *June* 13, 1931.—The susceptibility of ferromagnetic materials in strong fields can be represented by the equation $\chi = dI/dH = a_1 + a_2/H^3$. The first term is due to the increase of the absolute value of I with increasing H in the monocrystals (crystallites) of which the substance is built up. It can be calculated by means of Heisenberg's theory. The second term is explained by the tendency of the magnetisation vector in each monocrystal to adjust itself, with increasing H, more and more nearly in the direction of the field. The constant N of the molecular field NI is, according to Weiss, independent of the temperature, but depends on the temperature according to Heisenberg. Observations show that the latter is correct. The absorption of heat in passing through the Curie point can be calculated with quantitative accuracy by means of the Heisenberg theory.
H. N. A.

3598. Magnetic After-Effect. H. Kühlewein. *Phys. Zeits.* 32. *pp.* 472–480, *June* 15, 1931.—There are magnetic effects which cannot be accounted for in highly permeable materials by attributing them to eddy currents or disturbances artificially produced such as friction, fracture, etc. These may be attributed to the " magnetic after-effect," and the present paper is devoted to the establishment of the laws, etc., governing the effect and its relationship to the magnetic induction for all conditions of magnetisation. The matter is investigated (1) by commutation of d.c. with varying frequency of commutation, and (2) direct measurement of the simultaneous increase in induction by means of the Helmholtz pendulum. The apparatus, method, technique and limits of error are described in detail. The materials under investigation include permalloy (annealed quickly), permalloy (slowly cooled), iron-nickel alloys similarly treated, high-carbon steel, permalloy with silicon, etc., the results in each case being recorded in tables and curves. Two methods are developed for the determination of the relationship between time and magnetisation. It is found that the time taken, as noted from the induction, for the magnetisation to

attain its final and full value, proceeds to a maximum with increasing field strength. The path of this time relationship in regard to the field strength is proportional to the path of the differential permeability. By means of an empirical formula the new curves for the various materials at given field strength in regard to the magnetic after-effect can be calculated.
S. G. B.

APPARATUS AND INSTRUMENTS.

3599. Natural Limits of Sensitiveness of Measuring Instruments. Part II. Galvanometer with Various Damping. G. Ising. *Ann. d. Physik*, 8. 8. *pp.* 911–928, *April* 10, 1931.—The natural limit of sensitiveness of a galvanometer determined by the mean apparent current and tension oscillations, which the Brownian movement of the galvanometer system expresses, is deduced for any method of damping. In order to make the consequences of the formula clearer, in place of the undamped vibration period the time of adjustment is introduced. Thus it is shown that, with given time of adjustment and feeble air damping, the theoretical limit of sensitiveness remains almost uninfluenced by the magnitude of the electromagnetic damping, if this (with exact aperiodic adjustment) increases from the critical value to infinity. An approximate expression is given for the limit of sensitiveness of the galvanometer as *fluxmeter*, together with indications as to a simple method for the measurement of very small changes of position. [For Part I see Abstract 3287 (1931).]
J. J. S.

3600. Determination of the Adjustment Security of Electrical Pointer Instruments. W. Oehlerking, H. Krauss and A. Griesbach. *Zeits. f. Instrumentenk.* 51. *pp.* 205–207, *April*, 1931.—By the adjustment security is understood the ratio of the counter-twisting moment to the friction moment. In the neighbourhood of the equilibrium point, however, the friction moment may be equal to or greater than the counter-rotation moment. Thus the pointer does not work to a point, but can operate within a band on any point. To characterise the adjustment security of an instrument the breadth of this band should be given as a percentage of the 90° throw. Thus the adjustment certainty might be defined as follows: $S_{90} = \{(a_0 \pm a_f)/90\} \times 100\ \%$, where a_0 is the ideal throw and a_f the breadth of the uncertainty region in scale divisions. This expression, however, gives an inconvenient sum because a_f is very small compared with a_0. The definition would then be $S_{90} = \pm\, a_f 100/90\ \%$. a_f is actually determined by the friction position. Then a_f is put in relation to the friction moment. This arrangement is further discussed mathematically with the help of diagrams. J. J. S.

3601. Tension-free Short-Circuit Switch for Elimination of Disturbance Tensions. L. Ebert and J. Lange. *Zeits. f. Instrumentenk.* 51. *pp.* 207–209, *April*, 1931.—In sensitive d.c. measurements parasitic tensions form the chief sources of error. These tensions may be thermoelectric or electrochemical and, with modern sensitive galvanometers and measuring circuits of small resistance, tensions of 10^{-7} to 10^{-8} volts which are sources of error may render the sensitiveness of the galvanometer entirely illusory. Various methods of obviating these foreign and misleading tensions have been devised. In the present paper a description is given of a switch which, without changing poles and only by the switching process, separates the foreign tension from the tension which is examined in a trustworthy way. J. J. S.

3602. Precision Measurements of Alternating Currents up to 2000 Amperes. A. H. M. Arnold. *Journ. Sci. Instruments*, 8. *pp.* 154–155, *May*, 1931.—Figures are given of the performance of a current transformer with nickel iron core, having a ratio 2000/1, operating on a burden of 100 volt-amperes at rated current. The ratio is within 3 parts in 10,000 of its nominal value in the frequency range 25 cycles per sec. to 100 cycles per sec. at full current to one-tenth of full current. In conjunction with a non-inductive resistance of accurately known value and an electrostatic voltmeter, the transformer may be used for measuring currents up to 2000 amperes with an accuracy of a few parts in 10,000.

AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

3603. Dosage in Radium Therapy. J. Murdoch. *Brit. J. of Radiology*, 4. *pp.* 256–284, *June*, 1931.—The difficulties of radium treatment dosage are discussed and the difference between the energy emitted by radium and the energy actually absorbed by the tissues in therapeutic work is pointed out. Various methods of dosage measurement of radium, dependent upon biological tests, photographic and photometric tests and ionometric methods are discussed. As regards the latter method, in addition to the difficulties which arise as in the similar measurement of X-ray energy, there is the further difficulty due to the relative size of the radium salt and the ionisation chamber. Attempts to overcome this by the use of very small ionisation chambers are enumerated, and an apparatus, due to Stahel of Brussels in 1928, is described in fair detail, in which hexane was used in place of air as an ionising medium. Unlike in the larger X-ray ionoquantimeters, the " wall effect " plays a relatively small part in the production of errors. The various units which have been suggested are detailed, and Stahel has utilised the measurement of the actual energy in terms of calories or ergs per c.c., the calorimeter used for the measurements being described. Isodosis curves for the intensities surrounding tubes of radium are then discussed, and the application of such curves to the distribution of the radiation energy, in actual clinical applications, when using flat radiators, are mentioned, including the variations of dosage which occur when a series of such flat radiators are varied as regards their relative distribution, so that cross-firing of particular radiators occurs. The clinical distribution of such flat radiators in actual practice, particularly as regards facial, buccal, tongue and uterine application, are then illustrated, in order to show the rational use of such moulded flat applicators, as based upon energy absorption. B. J. L.

3604. Photoelectric Measurement of the Radiation from Mercury-Vapour Lamps and from the Sun, and the Effects of such Radiations upon the Skin. W. R. G. Atkins. *Roy. Dublin Soc., Proc.* 20. *pp.* 49–65, *May*, 1931.

3605. Medical Applications of Very Short Waves. P. Ancelme. *Onde Élec.* 10. *pp.* 221–232, *May*, 1931.—A résumé of experiments made by the author on the effects of very short electromagnetic waves (3 to 8 m.) on biological objects. The theory of the action of the waves is discussed, more particularly the heat production in the complex network of materials afforded by living tissues. The apparatus employed is described, as well as experiments on colloids, microbes, liquids and finally the heating effects in animals and malignant tissues. W. V. M.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

3606. Influence of Particle Size of Charcoal on Adsorption in Solutions. F. Krczil. *Kolloid Zeits.* 55. *pp.* 143–148, *May,* 1931.—The grain-size composition of two active charcoals is determined. By means of a large pipette apparatus fractions of definite sized grain are obtained. For a few active charcoals the influence of the grain-size of the active charcoals, within a definite range, on the taking up of dissolved substances is determined. It has been found that diminution of grain-size beyond that usually employed in practice does not lead to an increase in power of adsorption with the exception of colouring matters in molasses. J. K.

3607. Adsorption of Colouring Matter by Hydrosol Granules. A. Boutaric and M. Doladilhe. *Comptes Rendus,* 192. *pp.* 1098–1099, *May* 4, 1931.—Reference is made to the ultrafiltration method through collodion of studying the adsorption of colouring matter from its molecular solutions by colloidal solutions. This method is, however, not applicable to a number of hydrosols of hydrophobic colloids. The authors describe a radiation absorption method by which the amount of colouring matter adsorbed by the granules of a colloid can be determined. Luminous radiations of long wave-length are employed. Results for ferric hydrate and arsenic sulphide, diamine blue and Victoria blue are given. It is shown that for a mixture of colouring matter and hydrosol the colouring matter which interferes with the point of luminous absorption is that portion of the granules not fixed by the colloid, and that the particles of colouring matter not fixed by the colloidal granules have the same sign as these granules, whereas those fixed are of opposite sign. J. K.

3608. Determination of the Energy Levels of Adsorbed Hydrogen and Oxygen by the Method of Electron Collision. N. I. Kobosew and W. L. Anochin. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 18–62, *June,* 1931.—An apparatus which is essentially a diode was set up, the plate of which was a piece of platinum containing the adsorbed gas. Electrons were accelerated to the plate at different potentials between the filament and plate and the increased rate of desorption due to the electron impact measured. Sharp maxima in the rate of desorption were observed at certain values of the applied potential. For hydrogen these potentials occurred at 9, 11 and 13·5 volts, and their position was independent of the nature of the platinum surface. Corresponding to these potentials it is suggested that there are three forms of adsorbed atomic hydrogen whose heats of adsorption are 9, 53 and 113 k. cal. respectively. The evidence suggests that all the adsorbed hydrogen is atomic. Similar experiments have been carried out with oxygen which indicate that it is adsorbed in both the atomic and molecular forms. From the electron efficiency the surface concentrations of the adsorbed gases was calculated. F. J. W.

3609. Adsorption of Iodine at Thin Layers of Sublimed Calcium Fluoride. J. H. de Boer. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 133–154, *June,* 1931.—Adsorption isotherms have been determined for iodine at thin vacuum-sublimed layers of calcium fluoride and the data interpreted by means of a formula previously derived [see Abstract 800 (1930)]. Scarcely any adsorption occurs at a glass surface. Experimental arrangements are fully described. The surface of the sublimed calcium fluoride increases with the speed of sublimation. H. H. Ho.

3610. Translational Motion of Molecules in the Adsorbed Phase on Solids. D. H. Bangham and N. Fakhoury. *Chem. Soc., J. pp.* 1324–1333, *June,* 1931.—When gases are taken up by charcoal an expansion of the charcoal occurs. It is suggested that this expansion is directly proportional to the two-dimensional pressure in the adsorbed phase. This assumption has been tested by plotting graphs of Mx/s against x, where M is the molecular weight of the adsorbed gas, x the percentage linear expansion of a charcoal containing s gm. of adsorbed gas per gm. of charcoal, for water, carbon dioxide, ammonia, sulphur dioxide, benzene and pyridine. The curves so obtained are analogous to the $PV - P$ curves of imperfect gases except in the case of benzene and pyridine. F. J. W.

3611. Determination of Sorption Isothermals on Charcoal by the Retentivity Technique with Carbon Tetrachloride and Water. A. J. Allmand and L. J. Burrage. *J. Phys. Chem.* 35. *pp.* 1692–1703, *June,* 1931.—It was previously stated that the isothermals obtained by the Burrage retentivity method [see Abstract 1016 (1931)] showed discontinuities, being made up of a series of loops cutting one another at definite pressures. This paper contains details of the results obtained, and deals, in particular, with the evidence for the discontinuous structure mentioned. Factors which may have affected the form of the final isothermals are discussed, but the opinion is expressed that a more refined technique would exhibit still further complexity. H. H. Ho.

3612. Behaviour of a Complex Colloid in an Electric Field. C. Antoniani. *Accad. Lincei, Atti,* 13. *pp.* 524–526, *April* 12, 1931.—A complex colloidal substance, containing 82·75 % of organic matter, has been obtained by extraction of a soil with 10 % NaOH solution. The iso-electric point lies at pH 7·4, and the behaviour of the substance in an electric field shows it to be a typical electronegative colloid when dispersed in feebly alkaline solution and an electropositive colloid in more strongly alkaline solution. The organic constituent acts as a protective agent only within certain limits of pH. H. F. G.

3613. Hydrosol of Silicic Acid. Part III. Stability of the Hydrosol and Influence of Electrolytes thereon. K. Inaba. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 303. *pp.* 277–287, *May* 26, 1931. *In English.*—Observations on the conductivity, viscosity and stability changes of alkaline solutions of silicic acid hydrosol [see Abstract 1707 (1931)] containing KCl or $BaCl_2$, and on the influence of these salts on the hydrosol, are recorded. When the NaOH concentration is 0·001 *N*, the charges on the particles and hence the viscosity are increased, and the stability decreased. In solutions more concentrated in alkali than 0·01 *N* the sol becomes stable and its viscosity is lowered; in this case the silicic acid is molecularly dispersed, with formation of sodium silicate. No coagulation occurs on adding HCl or $BaCl_2$ to a solution in alkali of less than 0·01 *N* concentration, but at greater concentrations of alkali the sol becomes very unstable, especially on addition of $BaCl_2$. At the alkali concentration 0·01 *N*, the silicic acid is molecularly dispersed, combining chemically with the salt added. Thus, 0·3 % silicic acid solution is to be regarded as a colloidal solution in alkaline solution of concentration below 0·01 *N*, and as a true solution in alkaline solutions of higher concentration. T. H. P.

3614. Liesegang Rings. O. F. Tower and E. E. Chapman. *J. Phys. Chem.* 35. *pp.* 1474–1476, *May*, 1931.—Reference is made to an earlier work [see Abstract 2852 (1929)] describing the preparation of rings of cadmium sulphide and zinc sulphide. In the present paper following the work of Hedges and Henley it is shown that the method of forming rings by coagulation does not always apply. Methods for making Liesegang rings of manganese, nickel and cobalt sulphides are given. J. K.

3615. Optical Study of Secondary Liesegang Rings. L. Bull and Suzanne Veil. *Comptes Rendus*, 192. *pp.* 1314–1315, *May* 26, 1931. —Photomicrographs of the secondary rings are described and discussed. At a sufficient distance from the centre, where the rings are sufficiently separated to permit of their individual examination, crystalline formations have been observed which cannot be discerned in the primary rings. [See also Abstract 2477 (1931).] H. F. G.

3616. Viscosity Isotherms and Differential Heats of Dilution of Aqueous Solutions. Z. W. Wolkowa and W. S. Titow. *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 51–58, *June*, 1931.—It has been shown previously that the values calculated by Fricke for the heats of dilution U_{0-15} of glycerol-water mixtures of high viscosity follow the isotherms $\left(\frac{1}{\eta}, V\right)$, where η denotes the coefficient of viscosity and V the specific volumes of solutions at different concentrations. Solutions of zinc, aluminium and magnesium chlorides, cane sugar, and glycerol have now been examined. It is found that if $U > 0$, the viscosity isotherms of aqueous solutions are either convex to the V-axis or rectilinear, so that, from the $\left(\frac{1}{\eta}, V\right)$ isotherms, it can be decided whether the values of U are negative or positive. T. H. P.

3617. Thermal Expansion and the Debye-Hückel Heat of Dilution. G. Scatchard. *Am. Chem. Soc., J.* 53. *pp.* 2037–2039, *June*, 1931.—Attention is directed to the inaccuracy of calculating the heat of dilution from the fundamental equation of the Debye-Hückel theory by differentiating at constant volume. For the case of a solution containing a single electrolyte, with the dielectric constant independent of the concentration, the complete equation is now derived. Neglect to allow for the thermal expansion is shown to result in considerable error, even in the limiting law. T. H. P.

3618. Theory of Mixed Phases. Part II. C. Wagner. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 177–186, 1931.—This paper deals with diffusion processes and contains the derivation of formulæ for the diffusion of components in mixed phases: (*a*) for the type iron nitride, Fe_4N, and (*b*) in the general case. Then follows the determination of the single diffusion constants of the components in mixed phases, together with a discussion of diffusion and ionic mobility. By more exact mathematical analysis of the experimentally determined diffusion velocities as a function of the activity gradients, it appears possible to distinguish between the mechanism of the wandering over intermediate lattices and empty places. [See also Abstract 1716 (1931).] H. H. Ho.

3619. Toughness and Hydrogen Content of Electrolytic Metals. Guichard, Clausmann, Billon and Lanthony. *Comptes Rendus,* 192. *pp.* 1096–1098, *May* 4, 1931.—The authors refer to earlier work of others [see Abstract 2843 (1931)], and now give results for the toughness and the hydrogen content of five samples of electrolytic iron prepared by different methods. Nickel and cobalt show the same absence of parallelism between toughness and hydrogen content. J. K.

3620. Impurities in Metals. F. Bitter. *Phys. Rev.* 37. *pp.* 1527–1547, *June* 1, 1931.—In order to arrive at a satisfactory understanding of many of the properties of metals, especially ferromagnetic metals, it is necessary to take into account the distorting effect of impurities and of other irregularities in the crystal lattice. The present paper is an attempt to describe some of the corrections that must be applied to the usual model of a perfect crystal before it can be expected to reproduce the properties of actual substances. Starting with the usual law of force between any two atoms—repulsion for small distances, attraction for large distances—the distortion of the lattice in the immediate neighbourhood of an atom of impurity is discussed, with especial reference to the significance of the formation of molecules. Phase distributions in substances capable of allotropy are described, together with the influence of impurities on such distributions. The existence of diffusion makes it possible to apply statistical mechanics to solid solutions. It is shown that, in general, atoms of impurity in solids do not exert long-range forces on each other by means of the distortions they produce in the lattice. This makes it possible to give simple formulæ for the distribution of concentration of the impurities. These distributions are sometimes far from uniform, and a phenomenon similar to opalescence in gases may occur. Applications of the above concepts to ferromagnetic solutions are pointed out, and it is suggested that the ferromagnetism of austenite containing in the neighbourhood of 0·8 % carbon may be due to the presence of small granules of α-iron resulting from local fluctuations in the distribution of carbon atoms. AUTHOR.

3621. Solidification Diagram of Calcium-Sodium Alloys. E. Rinck. *Comptes Rendus,* 192. *pp.* 1378–1381, *June* 1, 1931.—The alloys of calcium and sodium are studied under conditions which exclude the presence of calcium nitride, since it has been shown that the earlier results were obtained with calcium which contained nitride. The two metals form reciprocal mixtures containing 7 % by weight of Na in Ca and 14 % Ca in Na. The existence of a eutectic is proved. The miscibility of the fused metals is investigated by a study of the reaction

$$Ca + 2NaCl \rightleftarrows 2Na + CaCl_2$$

at 850° C., and the results indicate that at temperatures above 1185° C. the metals are miscible in all proportions. F. J. B.

3622. Atmospheric Corrosion of Metals. Part I. Corrosion of Copper, Particularly the Influence of Sulphur Dioxide in Air of Various Relative Humidities. W. H. J. Vernon. *Faraday Soc., Trans.* 27. *pp.* 255–276, *June*; *Disc.,* 582–594, *Sept.,* 1931.—The action on copper of air of zero humidity and containing various concentrations of SO_2 is indistinguishable from that of purified air, but introduction of water vapour causes immediate differentiation among the different concentrations of SO_2. Corrosion-time curves for relative humidities of 50–99 % are exponential in the early stages, but, later, flatten out and become nearly parallel to the time axis in 30–40 days. The process is controlled by the catalytic oxidation of SO_2 at the metal surface, the rate of attack falling off as the active centres are used up. Between 63 and 75 % relative humidity a profound increase in the rate of attack mostly occurs, corresponding with a critical humidity. The corrosion-SO_2-concentration curves show a minimum at about 1 % of SO_2. At this point the reaction product is normal $CuSO_4$, which is accompanied by excess of base at lower, and by excess of acid at higher concentrations. In large excess over the SO_2, CO_2 is without appreciable influence, but HCl in small proportions pursues an independent and much greater attack of the metal. High-conductivity copper is attacked more rapidly than arsenical copper, possibly owing to the more hygroscopic nature of the products formed. [See also Abstract 2412 (1927).] T. H. P.

3623. Relation of Moisture in Rust to Critical Corrosion Humidity. W. S. Patterson and L. Hebbs. *Faraday Soc., Trans.* 27. *pp.* 277–283, *June*; *Disc.*, 594–595, *Sept.*, 1931.—Rust still holds from 50 to 20 % of water, even after lengthy exposure to dry conditions, and takes up only 5 to 7 %more when taken through a whole range of atmospheres of from 0 to 100 % humidity. Thus, the condition of the water rather than its amount is an important factor in the promotion of corrosion by rust. The small additional amount of water taken up, at and above the critical humidity, scarcely suffices to explain the very large increase in speed of corrosion when rust-coated metal is kept above the critical humidity. The type of the curves connecting mols, of water per mol. of ferric oxide in the rust with changes in the humidity, and the marked hysteresis between values obtained with increasing and decreasing humidity, indicate that rust has a gel structure. On the basis of Zsigmondy's theory of gel structure, it appears that, during the slight loss of moisture by rust when the humidity drops from 100 to 40 %, the exterior surface of the water in the capillaries of the gel has changed from the plane surface in equilibrium with the saturated atmosphere to stages of increasing curvature. At about 40 % saturation the smallest possible value for this radius of curvature has been reached, so that under lower saturation conditions water is given up to the atmosphere in relatively larger quantities than at the higher vapour pressures, " free " water being unable to remain in the rust. The residual water is strongly adsorbed by the surface of the gel and the walls of the capillaries. T. H. P.

3624. Passive State of Chromium. W. J. Müller. *Zeits. f. Elektrochem.* 37. *pp.* 328–330, *June*, 1931.—The active and passive states of chromium are considered to be due to the porosity of the surface layer. Previous work of the author and his co-workers has shown the effect of the surface layer on the potential of the underneath metal, and they concluded that the conductivity of the pores was equal to the conductivity of the surface layer. The porosity of the surface layer is developed to account for the different behaviour of chromium in various acids, for the existence of different temperatures of activation and for the activation by kathodic hydrogen. F. J. B.

3625. Gas Reactions with Atomic Oxygen. P. Harteck and U. Kopsch. *Zeits. f. phys. Chem.* 12. *Abt. B.* 5. *pp.* 327–347, *May*, 1931.—Oxygen rich in the atomic form is prepared by means of the glow discharge at about 1 mm. pressure, and the reaction of the atomic oxygen upon a number of substances in the gaseous phase is investigated. In many cases reaction luminosity has been observed. A number of properties of atomic oxygen are discussed, such as the formation and decomposition of ozone by its aid. H. H. Ho.

3626. Influence of Chemical Linking on the Properties of Polar Molecules in the Vapour State. K. Butkow. *Zeits. f. phys. Chem.* 12. *Abt. B.* 5. *pp.* 369–376, *May*, 1931.—It is shown that the heat of dissociation of polar molecules (MX) during the conversion of ionic molecules to atomic molecules diminishes systematically with growth of the ionisation potential of the positive partner and approaches the heat of dissociation of non-polar molecules (X_2). Thus the energy of decomposition of the molecule into ions continuously increases. The product (pq) of the exponents in the expression for the potential energy of the molecular nucleus increases with increase of the ionisation potential of the positive partner. Moreover, the Rosen-Mecke constant changes systematically on transformation of ionic to atomic molecules. A table showing the heats of dissociation for CsX, RbX, KX, NaX, LiX, TlX, AgX and CuI, founded partly on spectroscopic determinations and partly on thermodynamic calculations, is given. T. H. P.

3627. Combustion Limits of Gas and Air-Vapour Mixtures at Low Pressures. Part II. E. Berl and K. Barth. *Zeits. f. phys. Chem. Bodenstein-Festband*, *pp.* 211–229, 1931.—In continuation of previous work [see Abstract 2694 (1930)], the combustion data have been determined for mixtures of air with ether vapour, CN, CS_2 vapour, acetylene and alcohol vapour, and for mixtures of CS_2 vapour with NO and NO_2. The influence of pressure has been investigated for purposes of elucidating the mechanism of combustion, since, below a minimum value of the critical ignition pressure, reaction no longer occurs. The position of the critical ignition pressure is dependent on the oxidation affinity of the combustible substance. In the combustion of dry mixtures of CN and air, only CO arises, even with excess of oxygen, but the presence of water enables CO_2 to be formed. The first intermediate product in the combustion of carbon compounds appears to be CO. H. H. Ho.

3628. Photographic Determination of Resistance to Explosion of Mixtures of Gases and Vapours. M. Aubert and R. Duchêne. *Comptes Rendus*, 192. *pp.* 1633–1635, *June* 22, 1931.—A note on an investigation in conjunction with the aeronautical services on the liability of exhaust and other gases to explosion as the consequence of a secondary reaction which proves to be more actinic than the primary explosion. The influence of the turbulence on the birth of the explosive wave is investigated, and the exhaust and other gases are observed at three points, namely, (1) the time of sparking or ignition, (2) a curve of darkness more or less intense, (3) the characteristic dark and rectilinear phenomenon corresponding to the detonation. A series of records were made photographically at increasing initial temperatures of the mixtures. At a certain temperature the record relating ignition to detonation disappears wholly, and on the films the record shows a white space between the ignition and the detonation. This temperature can be determined with precision, and it is suggested that it characterises the resistance to detonation of the mixture. This point is further discussed in its various aspects. S. G. B.

3629. Measurement of Thermal Changes. H. Ramstetter and G. Hantke. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 662–668, 1931.—Full details are given of a new method applied to the measurement of the heat of formation of potassium hypochlorite, the heat of solution of ammonia, the heat of neutralisation of aqueous sodium hydroxide by sulphurous acid, and the heat of solution of sulphurous acid. H. H. Ho.

3630. Photosynthesis in Tropical Sunlight. Parts I and II, G. G. Rao and N. R. Dhar. *J. Phys. Chem.* 35. *pp.* 1418–1432, *May*, 1931.—In Part I data are given for the formation of formaldehyde from carbon dioxide and water in the presence of the following photosensitisers and sunlight: chlorophyll, methylene blue, malachite green, methyl orange, ferric hydroxide sol, uranyl nitrate, chromium sulphate and copper sulphate. Great precautions were taken in view of the adverse criticism. Small quantities of CO were obtained from the photochemical reduction of CO_2 by chlorophyll. Part II deals with: (*a*) Photosynthesis of formaldehyde and carbohydrates from alkali bicarbonates in the presence of coloured insoluble substances, such as colloidal ferric hydroxide, cobalt and nickel carbonates; (*b*) the polymerisation of formaldehyde to reducing sugars; (*c*) discussion of the data of Parts I and II from which the following mechanism is suggested for the photosynthesis of formaldehyde, *viz*., (1) reaction of chlorophyll with carbonic acid under the influence of light, with formation of chlorophyll peroxide and CO; (2) the interaction of the nascent CO with water to give instantaneously $H_2O + CO \rightarrow H.CHO + (O)$ and regeneration of chlorophyll from the peroxide with total elimination of oxygen; (3) polymerisation of formaldehyde to sugars. Evidence is adduced in support of the above theory that oxygen is evolved in two stages. H. H. Ho.

3631. Quantum Yield in the Photolysis of Silver Chloride. P. Feldmann. *Zeits. f. phys. Chem.* 12. *Abt. B.* 6. *pp.* 449–466, *June*, 1931. —A description is given of a potentiometric method of following the splitting-off of Cl during the illumination of AgCl precipitates under nitrite solution as chlorine acceptor. The quantum yield at 365 $m\mu$ reaches values which, within the experimental error of a few per cent., are equal to unity and diminish on continued illumination. Various irregularities noticed at the beginning of the illumination are dealt with elsewhere [see following Abstract]. T. H. P.

3632. Photolysis of Silver Chloride. P. Feldmann and A. Stern. *Zeits. f. phys. Chem.* 12. *Abt. B.* 6. *pp.* 467–477, *June*, 1931.—The quantum fields on illumination of AgCl, under nitrite solution at 365 $m\mu$, are equal to unity down to the smallest amounts of decomposition. The low values found by the potentiometric method [see preceding Abstract] immediately after the cessation of a short illumination are regarded as due to the establishment of the potential not being instantaneous. The absorption in the visible region conditioned by silver nuclei formed by previous illumination of the AgCl precipitates (at 365 $m\mu$) will cause no formation of Cl exceeding in magnitude the experimental error. On illumination under water, owing to the inverse reaction, the quantum yield is only about 0·5; no appearance of HClO was observed. Without nitrite solution the course of the potential is anomalous. T. H. P.

3633. Influence of Wave-Length upon the Photochemical Reaction between Ethylene Iodide and Iodine. H. J. Schumacher and G. Stieger. *Zeits. f. phys. Chem.* 12. *Abt. B.* 5. *pp.* 348–352, *May,* 1931.—This paper continues a previous investigation [see Abstract 1721 (1931)], and examines the influence of wave-length upon the reaction between ethylene iodide and iodine in CCl_4 solution. The quantum yield in the band region is appreciably smaller than in the continuum, and for the wave-lengths 436 to 546 and 578$\mu\mu$ is in the ratio of 1 : 6. H. H. Ho.

3634. Yield-Ratio (1 : 2) in Photochemical Reactions. F. Weigert and Franziska Pruckner. *Zeits. f. phys. Chem. Bodenstein-Festband, pp.* 775–784, 1931.—During the photochemical transformation of *o*-nitrobenzaldehyde into *o*-nitrobenzoic acid, for the wave-length region 313–436 mμ, and the aldehyde concentration 8–0·02 %, the yield ratio ν of 0·5 is obtained with reproducibility. A deviation from the value 0·5 in the violet for concentrations below 0·5 % shows that a deviation from Beer's law occurs. Acetone as solvent acts as a sensitiser of the second order for short-wave light, and its use has indicated that the photochemical reaction has a less simple mechanism than was to be deduced from the reaction equation. The polymerisation of anthracene to dianthracene and the reduction of quinone are also discussed. H. H. Ho.

3635. Quantum Theory of Chemical Kinetics. L. Goldstein. *Comptes Rendus,* 192. *pp.* 1536–1539, *June* 15, 1931.—The formation of a homopolar molecule from its components is discussed mathematically by means of Schrödinger's wave equations, and illustrated by experimental results relating to the recombination of free hydrogen atoms [see Abstract 659 (1931)]. J. S. G. T.

3636. Chemical Reactions in Ionised Gases. Synthesis of Nitric Acid. M. Laporte. *Comptes Rendus,* 192. *pp.* 1555–1558, *June* 15, 1931.—The synthesis of nitric acid through the agency of the l.f. electric discharge passing through a mixture of nitrogen, air or oxygen and water vapour is investigated. The yield is very small, and is a maximum (about double that with air) when the oxygen concentration is about three parts per 1000. J. S. G. T.

3637. Temperature Coefficients of the Single Potentials of Copper and Silver. R. Burian. *Zeits. f. Elektrochem.* 37. *pp.* 238–251, *May,* 1931.—The temperature coefficients of $Cu/CuSO_4$ aq. and $Ag/AgNO_3$ aq. potentials were determined over a considerable range of concentrations. The normal potentials were calculated from the results of measurements of the 0·01M solutions. The results agreed within the limits of accuracy of the method, with the results of calculations based upon freezing-point data, and from conductivity data for the activity coefficients. The entropy of dissolved silver and copper ions was calculated from the temperature coefficients of the normal potentials. The temperature coefficient of the calomel normal electrode was also redetermined. F. J. B.

3638. Oxidation-Reduction Potentials. Part IV. Ferric-Ferrous Electrode. S. Popoff, V. B. Fleharty and E. L. Hanson. *Am. Chem. Soc., J.* 53. *pp.* 1643–1651, *May,* 1931.—Chemical investigation of the reaction $2Fe^{+++} + 2Hg \rightleftarrows 2Fe^{++} + Hg_2^{++}$ shows it to be truly and easily reversible. Its equilibrium constant, calculated either from total concentration by suitable graphic and mathematical treatments or from the ionic strength of dilute solutions, is 0·0180 ± 0·0005. The principle of ionic strength may not be considered to hold even with concentrations as low as 0·01, when too much acid compared with the salts is present. The oxidation-reduction potential of the ferric-ferrous electrode is calculated from the equation $E_{0Fe} = E_{0Hg} - \frac{0{\cdot}05915}{2} \log K$ to be $-$ 0·7473 volt, which agrees well with the value, $-$ 0·7477 volt, obtained by Popoff and Kunz [see Abstract 2028 (1929)] by means of e.m.f. measurements. [For Part III see Abstract 2884 (1931).] T. H. P.

3639. Solution Tension of Sodium in Solvents other than Water. F. K. V. Koch. *Chem. Soc., J. pp.* 1138–1143, *May*, 1931.—Previous results [see Abstract 1774 (1928)] showed that no simple relationship exists between the solution tensions of silver in ten organic solvents and the corresponding dielectric constants of the solvents. Similar results are now given for the sodium ion, which, unlike silver, has an electronic configuration of the inert gas type. The cells investigated were of the type Na amalgam | NaI pyridine | NaI other solvent | Na amalgam, the concentration of the sodium in the amalgam being the same on both sides of the cell; eight organic solvents were tested in this way. The results show that, for the sodium ion, the dielectric constant is not the only property of the solvent of which the solution tension (or normal potential) is a function, such tension being dependent also on specific ionic-molecular forces. Moreover, the order of the solvents with regard to the solution tension of sodium is quite different from that for silver. T. H. P.

3640. Technique of Polarographic Measurements. P. Herasymenko. *Faraday Soc., Trans.* 27. *pp.* 203–205, *May*, 1931.—Lloyd's conclusion [see Abstract 2369 (1930)] *viz.*, that the polarographic method is unsuitable for hydrogen overpotential measurements, is criticised, and his results are attributed to the use of an incorrectly damped galvanometer with too long a period of swing. H. F. G.

3641. Poisoning of Hydrogen Electrodes. A. H. W. Aten and (Miss) M. Zieren. *Am. Electrochem. Soc., Trans.* 58. *pp.* 153–176; *Disc.*, 176–177, 1930.—The poisoning of the hydrogen electrode was studied, using arsenious oxide as a poison. Commercially pure sodium hydroxide and sulphuric acid were found to contain a substance which had a poisoning action on platinum electrodes. The poison was removed by treating the solution repeatedly with a black platinum electrode. The electrodes were regenerated after the poisoning by anodic polarisation. F. J. B.

3642. Quinhydrone Electrode. Part III. J. L. R. Morgan and Olive M. Lammert. *Am. Chem. Soc., J.* 53. *pp.* 2154–2168, *June*, 1931. —Continuing previous work [see Abstract 2508 (1931)], a study of the quinhydrone electrode was made in 0·1 *N* HCl. The electrodes were made of metals and graphite of different sizes and ages, sources and compositions. It was found that gold electrodes from whatever source gave erratic results, unless the area of the electrode was greater than 1 sq. cm. Gold electrodes gave cells which had lower current capacities than platinum electrodes of the same size and conditions. The reproducibility of gold-plated electrodes was not so satisfactory as either gold, platinum or graphite. Platinum—10 % iridium, platinum—10 % rhodium alloys and gold-plated electrodes did not develop the same potentials; c.p. platinum or 24-carat gold were negative to the alloys and plate. The difference disappeared when the solution was stirred with a current of nitrogen. F. J. B.

3643. Zero Charge on Silver. M. Proskurnin and A. Frumkin. *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 29–40, *June*, 1931.—Two methods are developed which permit the independent observation of the adsorption effects which occur when a gas-free silver surface is brought into contact with an aqueous solution. In these methods the silver and the solutions are freed from adsorbed and absorbed gas by heating in a high vacuum. The subsequent measurements are made in the apparatus and *in vacuo*. The zero charge on an etched silver surface is found to be $e_h = 0{\cdot}51$, a result in good agreement with the results of Billitzer and Bennewitz.
F. J. B

3644. Haber Glass Cell. J. Zirkler. *Zeits f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 75–76, *June*, 1931.—It is shown that the e.m.f. of the Haber glass cell varies with the nature of the glass. The matter is to be further investigated. [See also Abstract 2882 (1931).] F. J. B.

3645. Calculation of Heat of Dissociation from Electrical Conductivity. J. Zirkler. *Zeits. f. Physik*, 69. 7–8. *pp.* 515–525, *May* 28, 1931.—The heat of ionisation of strong electrolytes may be calculated from the temperature coefficient of the chemical equilibrium by employing the "true" degree of ionisation of Nernst. The variation of conductivity with temperature over the interval 0°–26° C. has been accurately determined for solutions of a number of uni-uni- and di-di-valent salts, and the calculated heats of dilution and of ionisation conform at least qualitatively to the Nernst hypothesis. H. F. G.

3646. Heat Content Values for Aqueous Solutions of the Chlorides, Nitrates, and Hydroxides of Hydrogen, Lithium, Sodium, and Potassium at 18° C. F. D. Rossini. *Bureau of Standards, J. of Research*, 6. *pp.* 791–806, *May*, 1931.—The existing data on the heats of dilution of the chlorides, nitrates, and hydroxides of hydrogen, lithium, sodium, and potassium at various temperatures and concentrations have been converted to one temperature, and a series of values for the concentration range from infinite dilution to about 2 molal have been obtained. The extrapolation to infinite dilution has been made with the aid of the Debye-Hückel theory of strong electrolytes. The data, exhibited in tabular and graphic form, give values for $\Phi_h - \Phi_h^\circ$, the relative apparent molal heat content of the solute, $\overline{H}_2 - \overline{H}_2^\circ$, the relative partial molal heat content of the solute, and $\overline{H}_1 - \overline{H}_1^\circ$, the relative partial molal heat content of the H_2O. The procedure employed in calculating the above quantities is given in detail. AUTHOR.

3647. Heat of Ionisation of Water. F. D. Rossini. *Bureau of Standards, J. of Research*, 6. *pp.* 847–856, *May*, 1931.—The heat of ionisation of water has been calculated by combining the data on heats of neutralisation given by Richards and Rowe and the data on heats of dilution recently compiled by the present author [see preceding Abstract]. The value so obtained is corroborated by using the data on heats of neutralisation reported by Gillespie, Lambert, and Gibson. For the reaction, $H_2O = H^+ + OH^-$, at infinite dilution in water and for the temperature range 10 to 35° C., the heat absorbed is given by the equation: $\Delta H = 13{,}721 - 57 \cdot 9(t - 18) + 0 \cdot 15(t - 18)^2$ g-cal.$_{18}$ per mole. The uncertainty is estimated to be ± 16 cal. per mole. Using the factor 4·181 for converting gm.cal.$_{18}$ to absolute joules gives $\Delta H = 57{,}370$ absolute joules per mole at 18° C. **Author.**

3648. Modified Equation for the Heats of Dilution of Solutions of Strong Electrolytes. O. Gatty. *Phil. Mag.* 11. *pp.* 1082–1089, *May,* 1931.—The use of the free energy or constant pressure function (F of G. N. Lewis) is shown to lead to the introduction of another term into the equations for heats of dilution of electrolytes. Denoting the osmotic coefficient of the solution by ϕ, the above term is

$$-(kT(1-\phi)\Sigma N_i)\frac{T}{V}\cdot\left(\frac{\partial V}{\partial T}\right)_p,$$

which for the simplest Debye equations reduces to

$$\Delta\frac{W}{2}\frac{T}{V}\left(\frac{\partial V}{\partial T}\right)_p = \kappa\frac{\Sigma N_i Z_i^2 \epsilon^2}{2D}\left[\frac{T}{3V}\left(\frac{\partial V}{\partial T}\right)_p\right].$$

$\frac{T}{3V}\left(\frac{\partial V}{\partial T}\right)_p$ is small compared with $\left[1 + \frac{T}{D}\left(\frac{\partial D}{\partial T}\right)\right]_p$ in the case of water, but becomes significant in the case of several non-aqueous solvents, *e.g.*, methyl and ethyl alcohols, and nitromethane. H. H. Ho.

3649. Rôle of Solvent in Electrolytic Dissociation of Salts. F. K. V. Koch. *Phil. Mag.* 11. *pp.* 1122–1129, *May,* 1931.—If $(A_S)_C$ and $(A_S)_A$ are the respective free energies of transference of the kation and anion from a vacuum to the pure solvent, $(A_S)_C = RT \log_e (a_S)_C$ and $(A_S)_A = RT \log_e (a_S)_A$, where $(a_S)_C$ and $(a_S)_A$ are the respective solvation activities. Further, if $(A_M)_C$ and $(A_M)_A$ are the free energies of transference of the kation and anion from a vacuum to the salt, $(A_M)_C = RT \log_e (a_M)_C$ and $(A_M)_A = RT \log_e (a_M)_A$, where $(a_M)_C$ and $(a_M)_A$ may be called the respective salt activities. The ratios $(a_S)_C : (a_M)_C = P_C$ and $(a_S)_A : (a_M)_A = P_A$ are the respective distribution coefficients of the kation and anion between the solvent and the salt, and these give a measure of the tendency of the ions to leave the salt and go into solution. P_C and P_A are similar to the Nernst solution tendencies, and may be termed the salt solution tensions. These considerations are used in discussing the various ways in which the electrolytic dissociation of a salt at a given concentration in a given solvent may occur, these ways being referable to one or more of four categories. The electrolytic dissociation constant must, in general, depend on specific ionic-molecular forces, and the solubility of a salt will, in general, depend on specific forces of solvation. Two formulæ correlating the dissociation constant with the dielectric constant of the solvent are given. T. H. P.

3650. Electrolytic Dissociation and Deviations from the Law of Dilution. K. Fredenhagen. *Zeits. f. Elektrochem.* 37. *pp.* 257–271, *May,* 1931.—Various objections are raised against the experimental data and the theoretical assumptions on which the electrostatic theory of electrolytic dissociation is based, and these are regarded as so serious that such theory should be discarded unless they can be refuted. A theory of electrolytic dissociation is advanced which does not assume dielectric action of the solvent, and is discussed in relation to: the true dissociation of pure solvents and fused salts; the change of the true dissociation with the temperature; the equilibrium between neutral dissociation in the gaseous phase and electrolytic dissociation in the liquid phase; the solubilities of salts and the tension series of the elements towards different solvents; the independence of the colour of strong electrolytes on the degree of dissociation; deviations from the dilution law. In all cases the new theory furnishes a better interpretation of the facts than the electrostatic theory. T. H. P.

3651. High-Voltage Anode Layer on Aluminium. J. E. Lilienfeld, L. W. Appleton and W. M. Smith. *Am. Electrochem. Soc., Trans.* 58. *pp.* 225–271; *Disc.*, 272–274, 1930.—Chemical and physical experiments on an aluminium anode, passivated, polarised or formed in a suitable electrolyte under conditions similar to those under which it is used in the h.t. electrolytic condensers, are described. The chemical experiments, covering wide ranges of concentrations, temperatures and current densities, were made with the object of ascertaining if, during the formation of the layer on the anode, the oxygen is deposited according to Faraday's law of equivalents. The results show that the total amount of oxygen released at the anode is quite different in order of magnitude from, and much larger than, the amount of oxygen included in the layer, the thickness of the latter being taken to be that usually assumed. The physical investigation indicates the behaviour of the layer to be that of a dielectric containing a large number of polar molecules. The properties of the layer are determined by the electric field in the layer, and hence by the potential applied to it. On the other hand, the current used in the initial or recurrent formation of the layer is only a secondary factor, and does not exhibit any fundamentally simple relations. Thus, the law of chemical equivalents cannot be broadly applied in determining either the capacity or the resistance of the layer on the basis of its formation process. T. H. P.

3652. Electrochemical Behaviour of Platinum in Hydrochloric Acid Solution. G. Grube and H. Reinhardt. *Zeits. f. Elektrochem.* 37. *pp.* 307–320, *June*, 1931.—Previous work [see Abstract 1264 (1930)] has shown that smooth platinum has anodic properties in strong hot HCl, and at 80° in 9·2 *N* HCl dissolves quantitatively in the tetravalent condition. In the present paper the equilibrium is investigated between metallic di- and tetravalent platinum in HCl solution. The equilibrium potentials of the various reactions are evaluated, and experiments made to obtain adherent compact platinum separations. The following equilibrium has been established: $2\,H_2PtCl_4 \rightleftarrows H_2PtCl_6 + Pt + 2\,HCl$, which with increasing HCl concentration and temperature is displaced towards the left. H. H. Ho.

3653. Electrokinetic Potentials. H. B. Bull and R. A. Gortner. *Nat. Acad. Sci., Proc.* 17. *pp.* 288–294, *May*, 1931.—Continuing previous work [see Abstract 2114 (1931)], this paper describes a new apparatus for measuring the potential at a liquid-liquid interface. The effect of changing the distances between the electrodes has been investigated and a position found which gives a maximum streaming potential. The temperature coefficient of the potential at an oil-water interface is found to be appreciable. The potential with solutions of NaCl, $CaCl_2$, $ThCl_4$ and sodium stearate against Nujol have been determined. $ThCl_4$ was found to reverse the potential at $0{\cdot}005 \times 10^{-3}\,N$, whilst sodium stearate tremendously increases the potential. The electrokinetic potential curves at an oil-aqueous solution interface resemble closely those at cellulose-aqueous solution interfaces, glass-aqueous solution interfaces, etc. H. H. Ho.

3654. Deviations from Helmholtz's Theory of Electrokinetic Phenomena. H. Reichardt. *Zeits. f. phys. Chem.* 154. *Abt. A.* 5–6. *pp.* 337–357, *May*, 1931.—Discussion of the theory of electroosmotic flow and of streaming potential in capillary tubes on the basis of modern views concerning the nature of the double layer shows that the velocity of migration of the electric charge carriers (ions) at the phase boundary in the field of the streaming potential is so small compared with the velocity of streaming of the charges that it does not influence appreciably the magnitude of the streaming potential. In narrow tubes the motion of the electric double-layer charges caused by a fall in pressure is diminished by the field forces of the streaming potential (electroosmotic counter-effect). Apart from the field forces, the actual streaming potential behaves to the potential like the electrolytic cross-section current to the total current. Since the electroosmotic convection current depends on the thickness of the double layer, this thickness may be determined from measurements of the electroosmotic counter-effect and for distilled water is thus found to be $1{\cdot}2 \times 10^{-7}$ cm. Lamb's view that special viscosity relationships prevail at the phase boundary is considered. T. H. P.

3655. Capillary Electrometer and Electrocapillary Curve. Parts I and II. F. O. Koenig. *Zeits. f. phys. Chem.* 154. *Abt. A.* 5–6. *pp.* 421–477, *May*, 1931.—I. The fundamental facts of the capillary electrometer and of the electrocapillary curve are explained, special reference being made to the experimental fact that determination of this curve succeeds only in presence of a large excess of foreign electrolyte. Application of the thermodynamic theory of the completely polarised electrode to the electrocapillary curve shows that four hypotheses are necessary in order that such application may lead to the usual identification of the inclination $\frac{\partial\sigma^{P}}{\partial E^{P}}$ of the curve with e, the charge density of the mercury surface in equilibrium with a solution of definite composition. Electrocapillary curves against which no objection can be raised are defined as those for which (1) the potential fall in the capillary occurs practically exclusively in a double layer at the boundary between mercury and solution, and (2) the changes in concentration produced in the capillary by polarisation are virtually limited to the mercury salt, the concentrations of all other constituents of the solution remaining unaltered up to the double layer. It is not known to what extent these two assumptions are fulfilled. When alkali metal salts are used as foreign electrolyte, amalgam-formation most probably plays no part in the electrocapillary curves.

II. A capillary electrometer with temperature-control and suitable for accurate measurements is described. It is found that the concentration of the ions determining the potential in a reference electrode employed as anode of the capillary electrometer must be greater than about 10^{-4} if the anode is to be non-polarisable. The curves obtained with quartz and glass capillaries are identical. T. H. P.

3656. Electroendosmosis and Surface Conductivity against a Glass Surface of Solutions of Hydrogen Chloride in Benzene and other Solvents. F. Fairbrother and M. Balkin. *Chem. Soc., J.*

pp. 1564–1578, *June*, 1931.—Results are given of measurements of the electroendosmosis through a diaphragm of sintered glass powder, and of the surface conductivity in similar glass powder, of solutions of dry HCl in benzene, CCl_4, cyclohexane and cyclohexene. The solutions in benzene show the greatest electroendosmosis, which increases with the concentration of the HCl, the glass being positively charged throughout. The solutions in cyclohexane show very slight electroendosmosis, the glass being positively charged, whilst the CCl_4 and cyclohexane solutions exhibit no measurable electroendosmosis. The solutions in all four solvents show surface conductivity, which is much smaller with cyclohexane than with the other solvents. It is shown that the surface conductivity is not caused by the electroendosmosis, and a mechanism is suggested to account for the surface conductivity by surface ionisation of the HCl. The solubilities of dry HCl in the four solvents have also been measured. T. H. P.

3657. Processes in the Solution and in the Gas Phase during Glow Discharge Electrolysis. A. Klemenc and H. F. Hohn. *Zeits. f. phys. Chem.* 154. *Abt. A.* 5–6. *pp.* 385–420, *May*, 1931.—During the glow discharge above an aqueous solution the short wave-length radiation emitted acts directly on the solution and produces therein a chemical change which is not related in any way to the ordinary electrolysis according to the Faraday laws. The glow space is separated from the surface of the solution by a type of Leidenfrost layer. A number of oxidation and reduction processes are described: the electrolytic reduction of chloric and perchloric acids takes place more readily under the action of the glow discharge than between metallic electrodes, so that a reaction between hydrogen and a metal cannot be a determining factor in such reductions; metals are precipitated by the discharge, with very low current yield, as oxide or hydroxide. The characteristics of the discharge, as regard chemical activity in relation to the current density and the pressure, conform quantitatively to the expression derived by Compton for a low voltage arc. A simple arrangement of apparatus is described whereby the active radiation may be detected. H. F. G.

3658. Secondary Phenomena in the Electrolysis of Sodium through Glass. J. H. de Boer and W. de Groot. *Zeits. f. techn. Physik*, 12. 6. *pp.* 303–305, 1931.—In presence of a salt layer the electrolysis of sodium through glass may give rise to a certain streaking, formed by the pencil of electrons leaving the kathode, and consisting of adsorbed sodium. The sodium may penetrate the glass in the ionic form and form streaks on the opposite wall. Certain shadow phenomena, occurring in absence of adsorbing layers and observed also by other experimenters, are attributed to positive ions formed in the neighbourhood of the negative end of the glowing wire. T. H. P.

3659. Electrolytes in Mixed Solvents. Part III. Molecular Refractivities and Partial Molar Volumes of Lithium Chloride in Water-Ethyl Alcohol Solutions. J. A. V. Butler and A. D. Lees. *Roy. Soc., Proc.* 131. *pp.* 382–390, *May* 1, 1931.—Determinations of the molecular refractivities and partial molar volumes of lithium chloride in a series of water-alcohol mixtures show that the molecular refractivity in each solvent is constant over the range of concentrations investigated, that it is hardly affected by the presence of alcohol until the molar fraction of the latter is over 20 %, but that with greater proportions of alcohol it falls off steadily to the value for pure alcohol. Certain assumptions being made, the proportions of water and alcohol molecules in contact with the ions are calculated, the proportion of water molecules in contact with the ions being always greater than their proportion in the solvent. The partial molar volume of lithium chloride is much smaller in 100 % alcohol than in water, and increases rapidly with the concentration; its variation with the composition of the solvent at a constant concentration of the salt is similar to that of the refractivity. [For Part II see Abstract 1423 (1931).] T. H. P.

3660. Boundary Layer of Dilute Electrolytes. Part II. M. Planck. *Preuss. Akad. Wiss. Berlin, Ber.* 7. *pp.* 113–122, 1931.—This question is discussed further [see Abstract 679 (1931)], and it is found necessary to discard the assumptions on which Henderson's formula [see Abstract 1245 (1907)] is based, since for the special case HCl/0·01 KCl an unacceptable value is obtained for the change of p.d. with time. New equations are derived for the constitution of the boundary layer of two electrolytes. T. H. P.

3661. Theory of Association of Strong Electrolytes. J. Zirkler. *Zeits. f. Elektrochem.* 37. *pp.* 252–254, *May*, 1931.—The latest measurements of freezing point depressions of strong electrolytes made in the Fajans Institute allow of the testing of Nernst's theory that both the osmotic pressure and the degree of association may be calculated from the conductivity, consideration being given to the electrostatic interaction of the ions [see Abstract 2533 (1928)]. Calculations of the degree of association of various uni-univalent electrolytes on the basis of Fajan's direct measurement of the heat changes agree satisfactorily with those deduced from Nernst's theory. T. H. P.

3662. Viscosity of Strong Electrolytes in very Dilute Solutions. H. Falkenhagen. *Phys. Zeits.* 32. *pp.* 365–369, *May* 1, 1931.—A theoretical paper, unsuitable for abstraction. T. H. P.

3663. General Limiting Law of the Viscosity of Strong Electrolytes. H. Falkenhagen. *Zeits. f. phys. Chem.* 13. *Abt. B.* 1–2. *pp.* 93–98, *June*, 1931.—The law of the dependence of the viscosity on the concentration, derived by Falkenhagen and Dole for the special case of a uni-univalent electrolyte with ions of equal mobility [see Abstract 1273 (1930)], is now extended to include all electrolytes. The results of the somewhat involved calculation are in good agreement with the experimental data. T. H. P.

3664. Apparent Molar Volumes of Dissolved Electrolytes. Part I. W. Geffcken. *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 1–28, *June*, 1931.—By means of extended and more exact experimental data, the relationship of O. Masson is confirmed, *viz.*, that the apparent molar volume of a dissolved salt throughout a wide concentration interval and for all temperatures is very exactly a linear function of the square root of the volume-concentration. H. H. Ho.

3665. Partial Molar Volume of Dissolved Electrolytes. Part I. O. Redlich and P. Rosenfeld. *Zeits. f. phys. Chem.* 155. *Abt. A.* 1. *pp.* 65–74, *June*, 1931.—A square-root law for the dependence of the partial molar volume on the concentration has been derived thermodynamically as a limiting law at high dilutions from the Debye-Hückel theory of electrolytes. Factors appear, apart from the universal constants, which depend on temperature, individual constants of the solvent and the type of electrolyte. H. H. Ho.

3666. Dependence of Conductivity of Strong Electrolytes on the Voltage. H. Falkenhagen. *Phys. Zeits.* 32. *pp.* 353–365, *May* 1, 1931. —The dependency of the conductivity of strong electrolytes on the frequency, which was deduced theoretically by Debye and Falkenhagen, and must arise as a consequence of the finite relaxation time of the ionic atmosphere [see Abstract 351 (1929)], has been observed experimentally and is closely related to the Wien effect [see Abstract 2754 (1927)]. For the dispersion phenomenon the limiting law of conductivity has been subjected to quantitative control, but for Wien's field-strength effect this has not been theoretically possible. It is now shown that, if certain simplifying assumptions are made, Wien's curves are deducible theoretically over their whole range. For the special case of symmetrical electrolytes with ions of equal mobility, the Wien effect is discussed theoretically and shown to agree quantitatively with the results obtained with magnesium sulphate. The dependency of the Wien effect on the concentration, temperature and dielectric constant is discussed from the theoretical standpoint and shown to agree qualitatively with experimental results, an interesting analogy between the dispersion effect and the Wien effect being revealed. T. H. P.

3667. Conductivity of Strong Electrolytes at Infinite Dilution. A. Ferguson and A. I. Vogel. *Faraday Soc., Trans.* 27. *pp.* 285–294, *June*; *Disc.*, 597–601, *Sept,*, 1931.—The authors, in a previous paper [see Abstract 651 (1926)], gave the available data for calculating the limiting value of the equivalent conductivity of strong electrolytes at concentrations approaching zero. The values were calculated by a graphical method for a large number of electrolytes. The method has been widely discussed and criticised, and the present paper constitutes a reply to recent criticism. F. J. B.

3668. Activity Coefficients and Heats of Transfer of Cadmium Sulphate. Application of the Extended Theory of Debye and Hückel. V. K. la Mer and W. G. Parks. *Am. Chem. Soc., J.* 53. *pp.* 2040–2061, *June*, 1931.—Results are given of e.m.f. measurements at 25° and 0° for the cell Cd-Hg (2 phase), $CdSO_4$ (M), $PbSO_4$ (solid), Pb-Hg (2 phase) over the concentration range 0·000458–3·698 molal. The potential of the cell (E_0) when the ion activities of cadmium sulphate are hypothetically 1 molal is 0·00142 volt at 25° and 0·01652 volt at 0°. The experimental data obtained furnish excellent confirmation of the extension of the Debye-Hückel theory as given by Gronwall, la Mer, and Sandved [see Abstract 2871 (1928)] for the region 0·0006–0·01 molal, since such extension yields constant and positive, physically plausible values of "*a*" (3·6 Å.), the closest approach of the ions, whereas the Debye-Hückel approximation gives steadily drifting and physically absurd values of "*a*." The activity coefficients and partial molal free energies of transfer of $CdSO_4$ at 25° and 0° are calculated for the concentration range 0·0005 molal to saturation. If $CdSO_4$ is incompletely dissociated in the classical sense, the influence of this on the activity coefficient is too small to be detected below 0·01 molal. The mean heat of the cell reaction, Cd (solid, saturated with Hg) + $PbSO_4$ (solid) = $CdSO_4$(M) + Pb (solid, saturated with Hg) at 12·5° and the corresponding excess electrical heats of transference of $CdSO_4$ are computed from the Gibbs-Helmholtz equation. T. H. P.